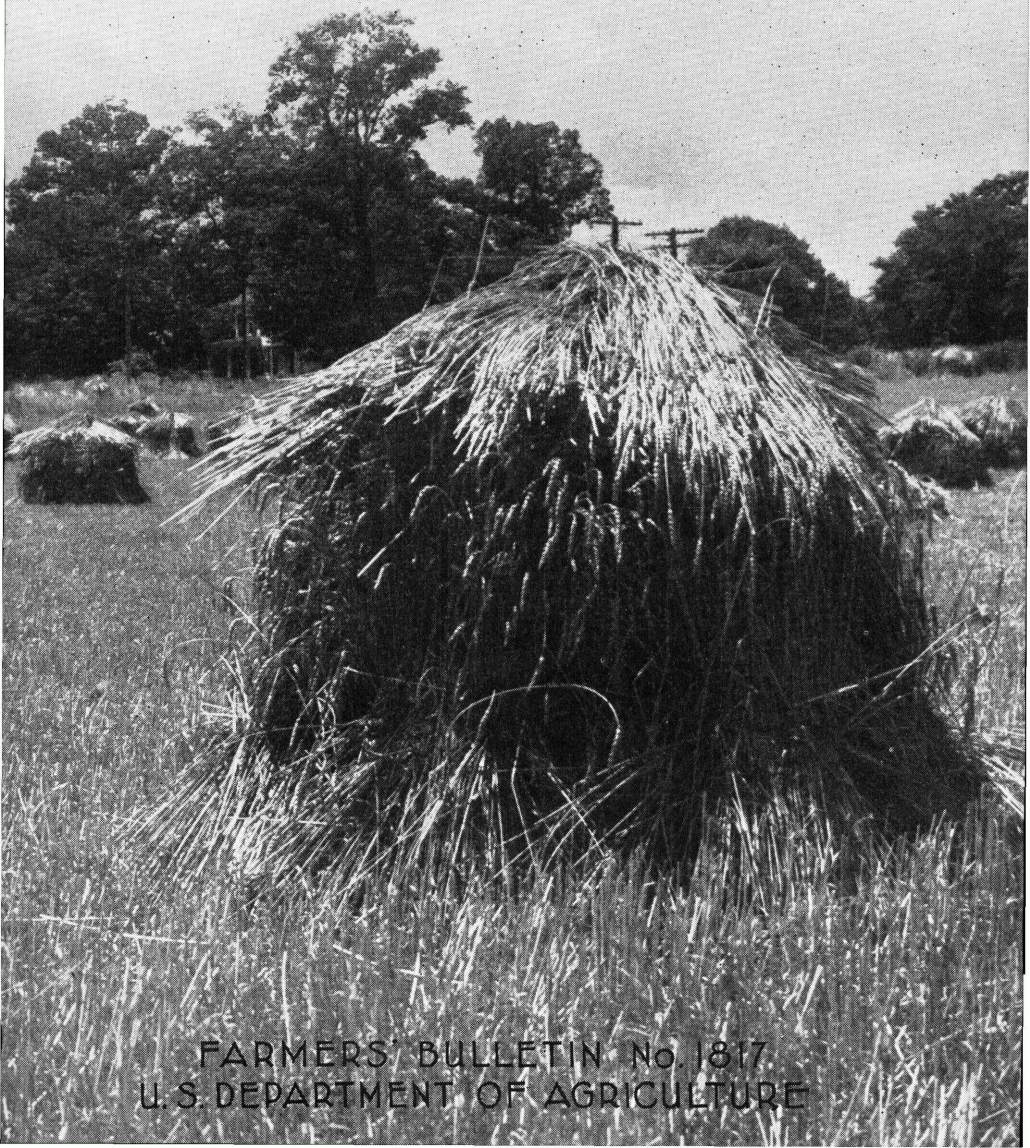
GROWING WHEAT IN THE EASTERN UNITED STATES



FARMERS' BULLETIN No. 1817
U. S. DEPARTMENT OF AGRICULTURE

WHEAT is one of the leading crops of the eastern United States. This region is made up of eastern Texas, eastern Oklahoma, eastern Kansas, southeastern Nebraska, Iowa, southern Wisconsin, and all States to the east, and produces about one-fifth of the country's wheat.

More than 75 distinct varieties of wheat are grown on a commercial scale in this region. Soft red winter varieties predominate, but white winter wheats are grown extensively in New York and Michigan, and hard red winter varieties are grown in Iowa, northern Illinois, northwestern Indiana, and southern Wisconsin, primarily because of their greater winter hardiness.

This wheat is grown largely as a supplement to other crops. It fits well into rotations and serves as an important cover crop to prevent soil erosion and leaching in the late fall, winter, and early spring, when the land would otherwise be bare. It is often grown because it can immediately be converted into cash. In the dairy sections wheat often provides very satisfactory pasture in the fall and winter, and its use for this purpose is increasing. In the Southern States wheat is occasionally grown for hay, especially in those areas where winter oats cannot be depended upon to survive the average winter. In certain years, especially when the hay crop is short, the value of the wheat straw for livestock farmers often approaches that of the grain itself. In addition to serving as roughage in the ration, it is invaluable for bedding and to conserve the value of manure. In many areas wheat is grown for local consumption as flour. There are many small mills throughout the region, and it appears to be desirable in many cases to produce and grind home-grown wheat rather than to ship flour in from distant States.

Wheat is best grown in rotation with other crops. In the region under consideration, suitable varieties, early preparation of the ground, timely seeding with reference to possible damage from the hessian fly, and winterkilling are considerations of primary importance. Commercial fertilizers may often be used to advantage.

This bulletin is a revision of and supersedes Farmers' Bulletins 596, 616, 885, 1168, and 1305.

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GROWING WHEAT IN THE EASTERN UNITED STATES

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CONTENTS

WHEAT IN THE EASTERN UNITED STATES

WHEAT is one of the leading crops of that part of the United States (designated for the purposes of this bulletin as the "eastern United States") composed of the eastern parts of Texas, Oklahoma, and Kansas, southeastern Nebraska, Iowa, southern Wisconsin, and all the States to the east (fig. 1). About one-fifth of the

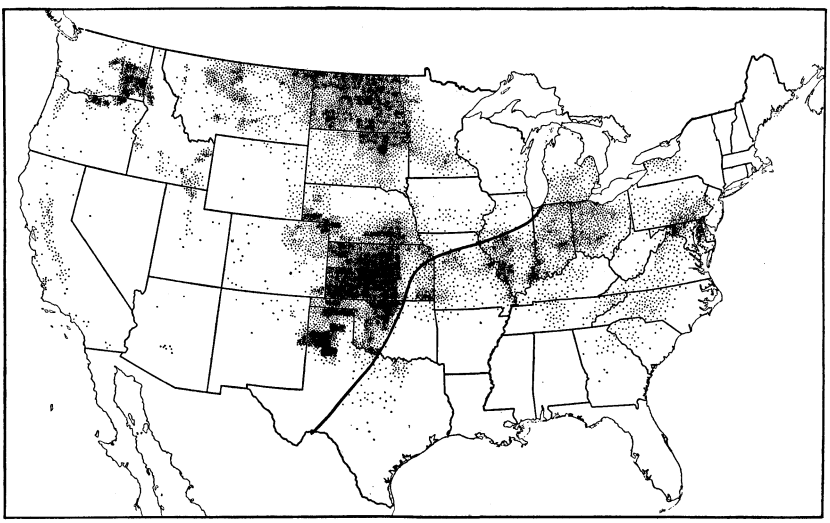

FIGURE 1.—Distribution of all wheat in the United States in 1934. Soft wheat is the principal kind grown east of the heavy black line. Each dot represents 5,000 acres. Total estimated area, 60,953,135 acres.

total wheat crop of the country is grown in this region, the western border of which coincides roughly with the line of a 30-inch average annual precipitation, and nearly all of the region has a precipitation of 30 inches or more. The western boundary also is, in part, based on the class and variety of wheat that is grown. Most of the wheat grown is soft red or soft white winter wheat which, in general, is softer in texture and lower in protein content than the hard wheats grown in the adjoining region on the west. These differences in texture and protein content are due, in part, to variety, but climate, season, and type of soil are also important. The boundary of the soft winter wheat region is somewhat irregular and overlapping as there is no sharp line of demarcation between the soft winter, hard winter, and spring wheat regions.

The region under consideration is largely one of diversified agriculture. Dairying, the raising of livestock and poultry, and the production of corn and forage crops are leading industries, and pasture crops are important throughout the region. Cotton is grown extensively in the South, but wheat is not so well adapted there and is grown only to a limited extent.

In most of this region, wheat is grown as a supplement to and in rotation with other crops, rather than for the grain itself. It fits well into different rotations and serves as an important cover crop to retard soil erosion and leaching in the late fall, winter, and early spring, when the land would otherwise be bare. Most rotations include a grass—timothy, for example—and a legume, such as red clover, alsike, lespedeza, or sweetclover, either singly or in various combinations. These can be seeded with the wheat in the fall or in the wheat in the late winter or early spring, according to the kind of grass or legume, and hence can become established without the loss of a year's time. The soil is protected from erosion and leaching in the meantime.

Wheat is often grown because it can be converted immediately into cash. In the dairy sections wheat often provides very satisfactory pasture in the fall and winter, and its use for this purpose is increasing. In the Southern States wheat is occasionally grown for hay, especially where winter oats cannot be depended upon to survive the winter. When the hay crop is short, the value of the wheat straw often approaches that of the grain. In addition to serving as roughage for livestock, the straw is invaluable for bedding and in conserving and supplementing the manure.

In many areas wheat is grown for local consumption as flour. There are many small mills throughout the region, and it appears to be more desirable and economical, in many cases, to produce and grind home-grown wheat than to ship in flour from distant States.

Most of the wheat of the eastern United States is produced in a relatively narrow but irregular belt extending across central Missouri and Illinois, including most of Indiana, Ohio, and southern Michigan, and southern Pennsylvania, northern Maryland, and Delaware. Less important are the piedmont (foot of the mountain) areas of North Carolina and Virginia, and western New York. Scattered producing areas are found in Kentucky, Tennessee, Virginia, West Virginia, Georgia, and South Carolina. Although the production of wheat in these areas is of little importance nationally, it plays an important

role in the agriculture of these localities, which depends to a considerable extent on how successfully wheat is grown. The best methods and practices for growing wheat, as well as some of the factors that contribute to success, are discussed in this bulletin.

CLIMATE AND SOIL FOR WHEAT

Wheat is adapted to a wide range of climate and soil. It is not well adapted, however, to very warm or moist climates unless there is a comparatively cool, dry season permitting its growth. High rainfall, especially if accompanied by moderate or high temperature, is not generally favorable for wheat because of diseases and difficulties in harvesting and threshing.

In the eastern United States wheat is commonly grown in rotations with corn and clover. Soils capable of producing satisfactory yields of either of these crops are well adapted for wheat. Like other small grains, wheat yields best on fertile, medium- to heavy-textured well-drained soils. In general it is not a satisfactory crop on poor, sandy soils or on poorly drained soils.

KINDS OF WHEAT

Wheat was unknown in North America prior to the discovery of the continent by Columbus in 1492. Hence the varieties that are now grown were introduced from the Old World or are descendants of such varieties. Columbus brought wheat with him from Spain on his voyage to the West Indies in 1494. Whether this particular introduction found its way to what is now the United States is not known, but it is certain that Spanish varieties were later introduced. The early English colonists brought seed with them, as did those from Holland and Sweden. Red May, a variety grown extensively at the present time, probably descended from Red Lammas, a variety grown in England during the seventeenth century and in Virginia prior to the Revolution.

It was traditional for colonists to take seed with them when moving to new countries. Consequently it is more than probable that varieties were introduced into the eastern United States from nearly every country of Europe during the period of colonization. In later years agricultural societies, State and Federal Governments, and especially in recent years the various State agricultural experiment stations and the United States Department of Agriculture have taken an active part in introducing new varieties.

Many of the varieties first brought to the eastern United States proved to be poorly adapted and soon disappeared. Others persisted for a time and were then replaced by better ones. The changes that have been brought about may perhaps be best appreciated from the fact that although no less than 75 distinct varieties are grown in the eastern United States at the present time, less than half a dozen of those in existence 100 years ago are grown today.

During the past 25 years efforts to obtain better varieties have depended mostly on selection and breeding rather than on introduction from foreign countries. Many of the varieties of the present day are a result of these efforts.

Nearly all wheat grown in the eastern United States is seeded in the fall and harvested the following spring or early summer. Usually such wheat is known as winter wheat. Varieties of true winter wheat, if sown in the spring, seldom produce heads, or at best only a few heads, and for all practical purposes result in failure. Where winter wheat will survive the winters, spring wheat is relatively unsatisfactory. It usually ripens later and hence is more likely to be injured by rust, scab, and other diseases and by unfavorable weather. Also, conditions for seeding are usually less satisfactory in the spring than in the fall. The yields of spring wheat usually are much less and the quality is poorer than may reasonably be expected from the better varieties of winter wheat. Spring wheats are occasionally grown in the New England States and in the States bordering the Great Lakes, but the acreage is small. Of the total acreage of wheat in the eastern United States, only about 0.5 percent is seeded in the spring.

Winter wheat is principally of two classes: hard red winter and soft red winter. More than 90 percent of the wheat grown in the eastern United States is of the latter class. Soft white winter wheat is also grown to a limited extent. Hard red winter wheat is grown principally in Kansas, Nebraska, and neighboring States in the Great Plains. It is so called because of its hard grain, which is high in protein. It is especially desirable for bread. The soft winter wheats have relatively soft grain, which is low in protein and produces flour best suited for pastries. Excellent bread, however, can be made from most varieties of soft wheat and from the flour of blends of soft and hard wheat.

In general, hard wheat is grown in dry, hot climates and on soil relatively rich in nitrogen, whereas soft wheat is grown in moist, cool climates and on soil relatively poor in nitrogen. When hard wheats are grown in the eastern United States the grain is harder than that of soft wheats, but much softer than when they are grown in the subhumid and semiarid Great Plains. The soft and mottled hard and soft condition of hard wheat kernels is known as yellow berry. Such grain usually is less desirable than that produced by typical soft varieties. The hard winter wheat varieties are nevertheless grown in certain localities because of their superior winter hardiness.

CHOOSING A VARIETY

Since many varieties of wheat are grown in the eastern United States it is often difficult to decide which are likely to be best for a particular State or locality. For example: Is it better to grow a red wheat or a white wheat? Do bearded varieties usually yield better than beardless varieties? Should disease resistance be considered? Are there important differences in quality, or is it sufficient to know that a given variety can be depended upon to give satisfactory yields? These and other questions merit consideration.

Yield is the characteristic by which a variety is most commonly judged. No variety may be considered satisfactory unless it is able to produce a good yield in comparison with others. However, yielding ability, or the tendency to produce generally satisfactory yields over a period of years, is a difficult characteristic to judge. One

reason for this is the great variation in seasons from year to year. Thus, a new variety may produce a very good yield for 2 or 3 years, when it is first introduced, but because of susceptibility to winter-killing or disease, etc., may later prove to be very unsatisfactory. For this reason farmers may well be skeptical of new and untried varieties, especially if extensively advertised and sold at a high price. In general about the only way to determine beyond a doubt whether a given variety is a good yielder is to grow it for a number of years, preferably in comparison with other well-known standard varieties. Usually this can be done most satisfactorily by agricultural experiment stations, where information should be sought if there is doubt as to the worth of a variety.

Much more soft red wheat than soft white wheat is grown in the region under discussion, the relative area in 1934 being about 95 and 5 percent, respectively. Soft white wheat is grown principally in New York and Michigan, where there is a special demand for this class for the manufacture of prepared whole-wheat cereals. In general white wheat runs lower in protein and is more satisfactory for pastries and less desirable for bread than is soft red wheat. Some white varieties are of special value because of their stiff straw and resistance to lodging.

Other things being equal, farmers of the Eastern States prefer beardless (or awnless) varieties. The beards are objectionable in harvesting and threshing, except when a combine harvester-thresher is used, and they also cause sore mouths when the straw is fed to farm animals. In spite of this, about one-third of the wheat produced in the eastern United States is of bearded varieties. Just why this is true has never been completely explained. There is considerable evidence to show that the beards perform important though unknown physiological functions in the final development of the grain, with the result that under some conditions bearded varieties tend to yield more than beardless varieties. In some areas bearded varieties are grown because they are more winter hardy or more resistant to diseases. There is, however, no consistent relation between the presence of beards and yield in the Eastern States, and other varietal characteristics are generally more important. In general it is better to depend upon the performance record of a particular variety than to choose one because it does or does not have beards.

A satisfactory winter wheat must be sufficiently hardy to survive winters of average or more than average severity. Winters fluctuate greatly in this respect. In 1928, for example, Illinois, Indiana, and Ohio lost approximately two-thirds of their acreage of winter wheat by winter-killing, and in 1934 and 1935 the New York crop suffered heavily from the same cause.

Winter-killing in the Eastern States has generally been thought to be due to heaving as a result of the alternate freezing and thawing of the soil in the spring. In this process the plants are lifted above the surface of the ground, and the roots are broken and exposed. The plants may be partially or completely killed. Recently it has been shown that death due to freezing of the plant tissue also occurs. Probably in many cases winter-killing is the combined result of the two.

In general the typical soft winter varieties are most resistant to heaving and least resistant to low temperatures, whereas the hard winter varieties are the reverse. Attempts are being made by several of the State agricultural experiment stations to produce new varieties that possess resistance to both causes of injury, but so far no such variety that is satisfactory in other respects has been produced.

If conditions are favorable throughout the growing season, late-heading and late-ripening varieties tend to produce the highest yields. Such varieties usually tiller more, have a larger leaf surface, and hence are able to use more completely moisture, sunlight, and the elements in the soil to produce grain. Usually, however, conditions are not favorable throughout the season. Rust, scab, septoria or glume blotch, and other diseases are likely to make their appearance in late spring; and in some areas the high temperatures of early summer are not the most favorable for growth. On poor soils the supply of mineral elements may be insufficient to carry the crop to maturity in the most satisfactory manner. Late-ripening varieties are also more subject to lodging. For these reasons early-maturing or medium-maturing varieties will usually produce better yields than those that require a longer growth period. Very early varieties, such as Gasta and Purplestraw, give the most satisfactory yields in the Coastal Plain as far north as Washington, D. C. In general somewhat later varieties can be grown in the Northern States, but nowhere is it advisable to grow very late varieties such as are grown in England, northern France, and Germany.

It is often desirable to grow an early variety in order to get the crop off the land early so that harvest will not interfere with other farm work or to give a grass or legume crop seeded with the wheat an opportunity to develop before hot weather. A difference of even a few days at this time of the year may be very important.

The tendency to lodge is a very important consideration in choosing varieties for this region, especially for soils rich in nitrogen, where lodging frequently occurs. Lodged grain is difficult and expensive to harvest, and if the lodging occurs before the grain is ripe the filling of the heads is interfered with, and a low yield, grain with a low test weight, and poor-quality grain are produced.

Varieties differ greatly in lodging. In general the hard winter varieties have weak straw and lodge easily. Most of the soft red varieties have reasonably stiff straw, and the soft white varieties have very stiff straw. The early varieties, grown extensively in the southeastern United States, have weak straw, but because they ripen early and have small heads they generally escape serious lodging.

As a general rule varieties which have very stiff straw produce but few tillers and vice versa. This probably has no great practical importance though it may explain why certain varieties, such as Genesee Giant and Fultzo-Mediterranean, which have unusually stiff straw, do not yield well and are not generally popular.

The most important wheat diseases in the eastern United States are bunt or stinking smut, leaf rust, stem rust, loose smut, septoria (leaf and glume blotch), and scab (see p. 41). Bunt, or stinking smut, and loose smut can be prevented by seed treatment; most other diseases can be controlled only by the use of resistant varieties so far as they are available. It is obviously desirable to use such vari-

eties if they are satisfactory in other respects. The resistance of varieties to the various diseases will be discussed in connection with that of each variety.

Soft winter wheat is used mostly for pastry, for general-purpose flour, and for whole-wheat prepared foods. Much of it is ground in small mills and used locally. Quality, insofar as it is determined by variety, receives less consideration than is the case for the hard winter or hard spring wheats grown in the Great Plains. Nevertheless, it should not be ignored in choosing a variety. At times the hard, high-protein wheat of the Great Plains sells at a premium over soft winter wheat, and the question often arises whether high-protein hard wheat cannot and should not be grown in the eastern United States. Some improvement can be made by breeding, but it is certain that wheat from the eastern United States cannot equal that from the drier areas in protein content and quality for bread. There is considerable doubt whether the growing of hard wheat in most of this region would be economically desirable even if feasible.

Some localities produce wheat mostly for their own use as bread. Very soft wheat, as, for example, the soft white varieties, produces a flour that is too weak, that is, too low in protein to make good bread. In such cases it may be more desirable to grow a variety moderately high in protein than to ship in hard winter or hard spring wheat for blending. Such, for example, seems to be the case in certain parts of Michigan where the variety Red Rock is grown.

VARIETIES FOR THE EASTERN UNITED STATES

About 75 distinct varieties of soft winter wheat are now grown on a commercial scale. Some have red, some have white grain; some have beards, and some are beardless. They also vary greatly in color of chaff and straw, in height, and especially in such important practical characteristics as winter hardiness, yield, quality, resistance to disease, time of heading and ripening, tendency to lodge, ability to tiller, etc. Because of the large number of varieties available and their great variation, with respect to these characteristics, the choosing of the best variety is often a difficult matter.

It is impractical to give an adequate description of all of the varieties grown in the eastern United States; consequently, the discussion which follows is limited to the more important ones. For convenience they are arranged in groups according to their resemblance to each other.

SOFT RED VARIETIES WITH BEARDLESS HEADS AND GLABROUS WHITE OR YELLOW CHAFF

The leading varieties of this group are Fultz, Trumbull, Fulhio, Ashland, Purplestraw, Gasta, Leap, Forward, Purkof, Harvest Queen, Flint, and Redhart.

FULTZ

Fultz is grown more extensively than any other variety in the eastern United States (fig. 2). It is one of the older varieties, having been originated in 1862 by Abraham Fultz, who increased it from three heads found in a field of bearded wheat in Mifflin County,

Pa. It appears to owe its wide distribution to general all-round excellence rather than to any particular characteristic. The straw is rather short, moderately stiff, and seldom lodges; the grain is of good quality, and under average conditions yields are satisfactory. It is grown throughout most of the eastern United States, but production centers especially in Missouri, southern Illinois, and Indiana and Kentucky. It is grown very little or not at all in Michigan and New York, and only sparingly in the area extending from northern Illinois to Pennsylvania, probably in part because of its lack of winter hardiness and also because of the production of superior varieties which have replaced it.

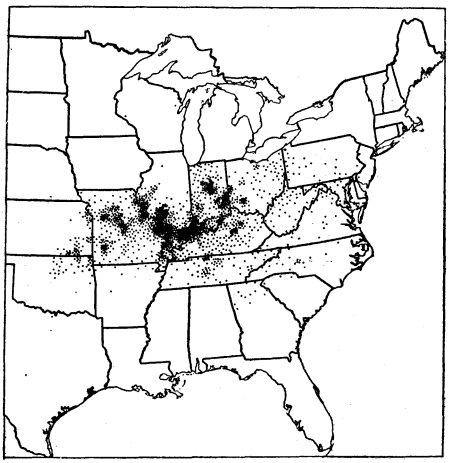

FIGURE 2.—Distribution of Fultz wheat in 1934. Each dot represents 1,000 acres. Estimated area, 1,870,380 acres.

This variety has slightly inclined, rather tapering heads of medium length and compactness. The kernels are rather small and soft and of a pale red color (fig. 3, *B*). The plants are of medium height and mature in midseason. They have a purple or reddish straw when ripe.

Fultz also is grown under many other names, such as Bluestem, Bluestem Fultz, Improved Fultz, Jersey Fultz, Tennessee Fultz, and others.

Fultz is recommended for growing in Arkansas, Indiana, Tennessee, and Virginia by the agricultural experiment stations of those States.

TRUMBULL

Trumbull, a selection from Fultz made at the Ohio Agricultural Experiment Station, has a taller, stiffer straw and in Ohio has yielded somewhat better than Fultz. The straw is a very light purple, and the heads are more erect than those of the parent. In recent years, it has increased rapidly in Ohio and now accounts for more than half the wheat acreage of that State (fig. 4). Like Fultz, it is somewhat deficient in winter hardiness. It is also somewhat resistant to loose smut. Trumbull is especially recommended for western Ohio.

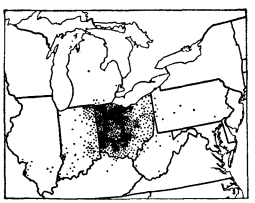

FIGURE 4.—Distribution of Trumbull wheat in 1934. Estimated area, 1,135,641 acres.

FULHIO

Fulhio also is a selection from Fultz made at the Ohio station and in appearance (fig. 3, *A*) is very similar to the parent variety. It is grown extensively in eastern Ohio and to a considerable extent in southern Illinois (fig. 5). In Ohio it appears to be somewhat more susceptible to loose smut and scab and has somewhat weaker straw

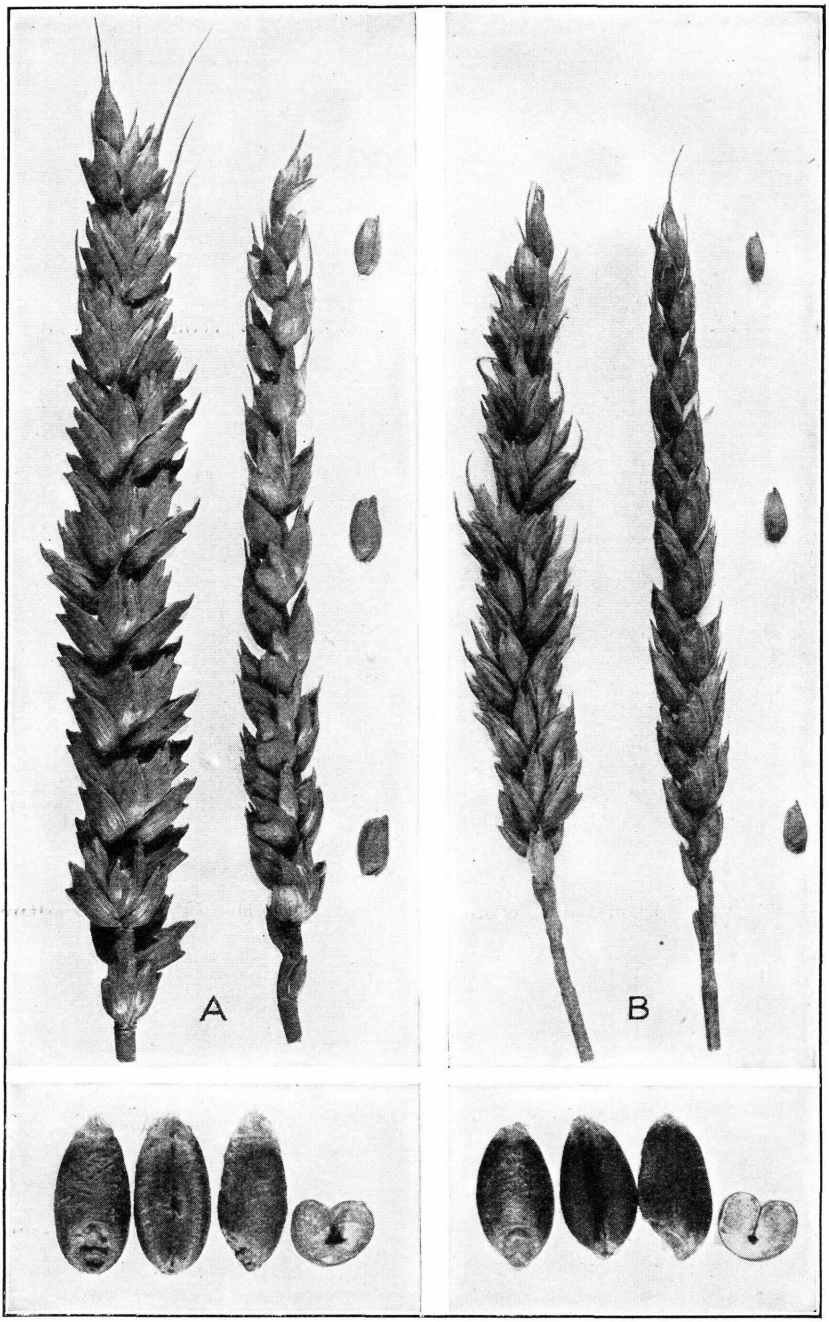

FIGURE 3.—Heads and grain of Fulhio (A) and Fultz (B) wheats.

than Trumbull, although better than Fultz. Otherwise it has all the good points of Trumbull and is somewhat more winter hardy. The Ohio station recommends it for eastern and especially northeastern Ohio.

ASHLAND

Ashland is a selection from Fultz made at the Kentucky Agricultural Experiment Station. It was first released for commercial growing in 1919 and is grown in Kentucky to a limited extent. The straw is stronger than that of Fultz, and the variety is claimed to be somewhat resistant to scab.

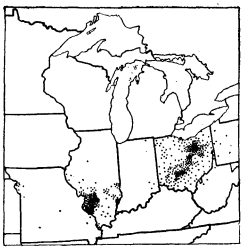

FIGURE 5.—Distribution of Fulhio wheat in 1934. Estimated area, 533,838 acres.

PURPLESTRAW

Purplestraw heads and ripens early. It is the leading variety along the lower Piedmont and the Coastal Plain from Virginia south (fig. 6). It is the leading variety in Georgia and South Carolina and the third most important in North Carolina. In this area its early maturity is a decided advantage in enabling it to escape damage from leaf rust and the high temperatures of early summer.

The variety tillers freely and has rather fine straw. Unlike other winter varieties under average conditions, it will head and produce a fair crop in a normal manner when sown early in the spring. The variety is one of the least winter hardy of the soft winter wheats and for this reason should not be grown north of Washington, D. C., nor at high altitudes south of Washington.

The observable head and grain characters of Purplestraw (fig. 7, *B*) somewhat resemble Fultz (fig. 3, *B*). The heads are shorter than Fultz, erect, and rather compact, and they have short-tip awns. The kernels are small, pale red, very soft, and of excellent quality for pastries. The straw, as the name implies, is generally purple or purplish in color.

Purplestraw is one of the oldest varieties in the United States, its known history extending back more than 100 years. Probably because of its long history in this country, it is known by a number of names, including Alabama Bluestem, Bluestem, Georgia Bluestem, Georgia Red, and Ripley.

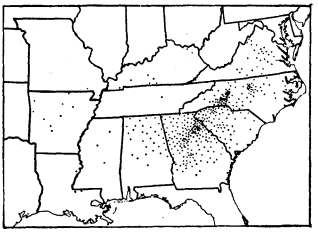

FIGURE 6.—Distribution of Purplestraw wheat in 1934. Estimated area, 306,028 acres.

GASTA

Gasta is a selection from Purplestraw made at the Georgia Experiment Station. It has recently been distributed to farmers for growing in that State. In experimental trials at the Georgia station, it has produced higher yields than Purplestraw, and has been more resistant to loose smut. It is very early maturing and also resembles the parent in other respects.

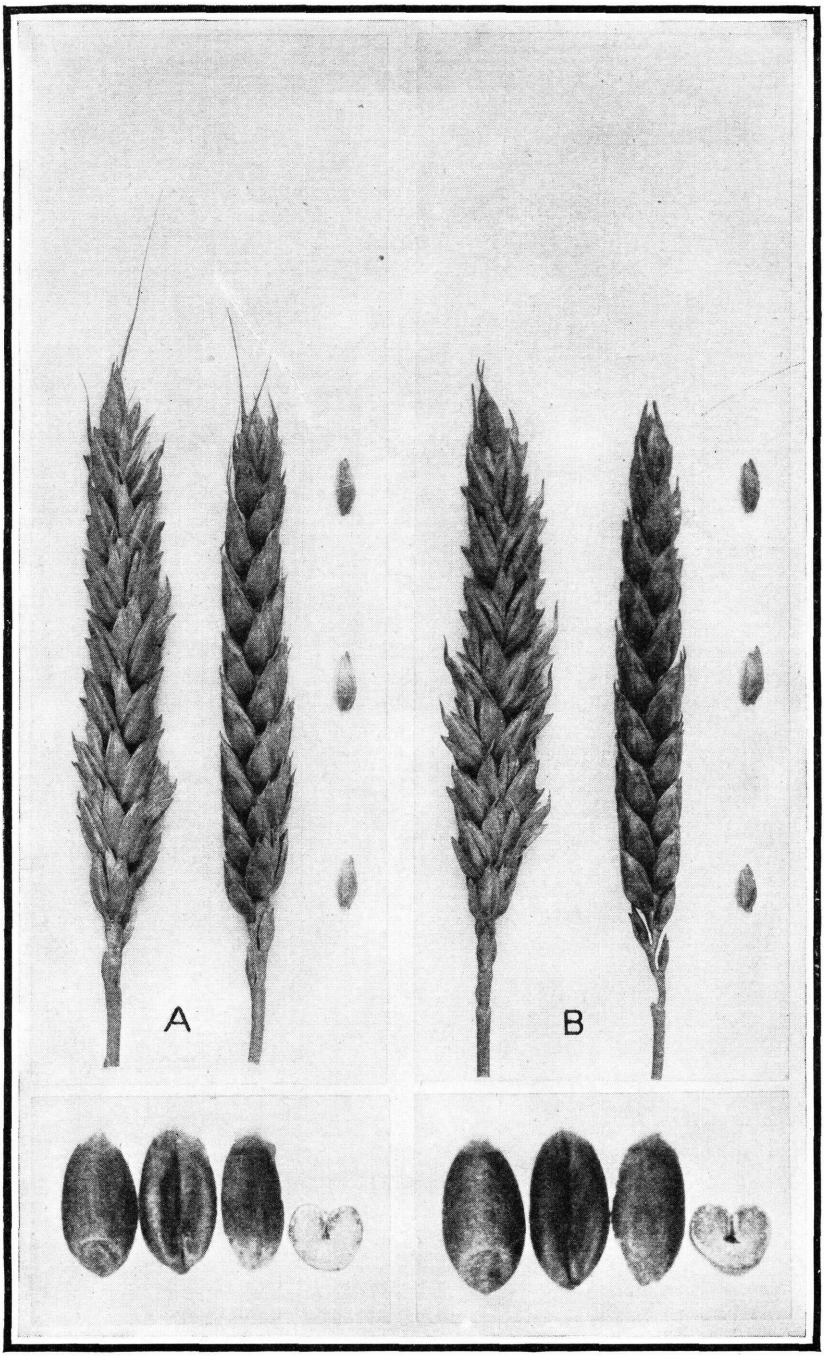

FIGURE 7.—Heads and grain of Flint (*A*) and Purplestraw (*B*) wheats.

LEAP

Leap is one of the leading varieties in southeastern Pennsylvania, northern Maryland, and Delaware (fig. 8). It is also grown in North Carolina, Virginia, and other South Atlantic States. Good quality of grain, satisfactory yields, a reasonably strong straw, and the fact that it is beardless apparently account for its popularity. It is distinctly defective in winter hardiness and should not be grown north of the area where it is now found.

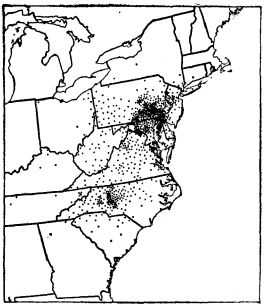

FIGURE 8.—Distribution of Leap wheat in 1934. Estimated area, 708,903 acres.

The variety can usually be distinguished from other beardless varieties by its yellow straw, the rather long, lax, tapering, and nodding heads, and by the brownish stripes on the chaff, which give the head a yellowish appearance (fig. 9, *A*). It is recommended for growing in Pennsylvania, New Jersey, Virginia, Maryland, and North Carolina by the agricultural experiment stations of those States.

FORWARD

Forward was originated from a beardless plant found in the bearded variety Fulcaster at the New York (Cornell) Agricultural Experiment Station. It was first distributed in 1920. It has been one of the highest-yielding varieties in New York and in recent years has found its way across Pennsylvania into northern Maryland and Virginia (fig. 10). It is grown, especially, in southeastern Pennsylvania. It is more winter hardy than Purplestraw or Leap, being approximately as hardy as Fulcaster or Fultz. It has short, stiff straw which does not lodge easily. It has not been especially popular in New York because of its red grain; white-kerneled varieties are preferred in that State. It has recently been increasing in acreage, probably because of its superior winter hardiness, and is recommended for growing in New York, Pennsylvania, and Virginia.

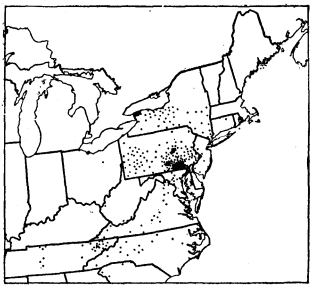

FIGURE 10.—Distribution of Forward wheat in 1934. Estimated area, 258,329 acres.

PURKOF

Purkof is usually classed as a soft red winter wheat, although it often produces rather hard or semihard kernels and on the market is sometimes classed as a mixed wheat. Heads and grain of this variety are illustrated in figure 9, *B*. The variety was produced by the Purdue University Agricultural Experiment Station from a cross between Red May (Michigan Amber) and Malakof and was distributed to farmers by that station. It is grown principally in Indiana but in recent years has found its way into Illinois and western Pennsylvania (fig. 11).

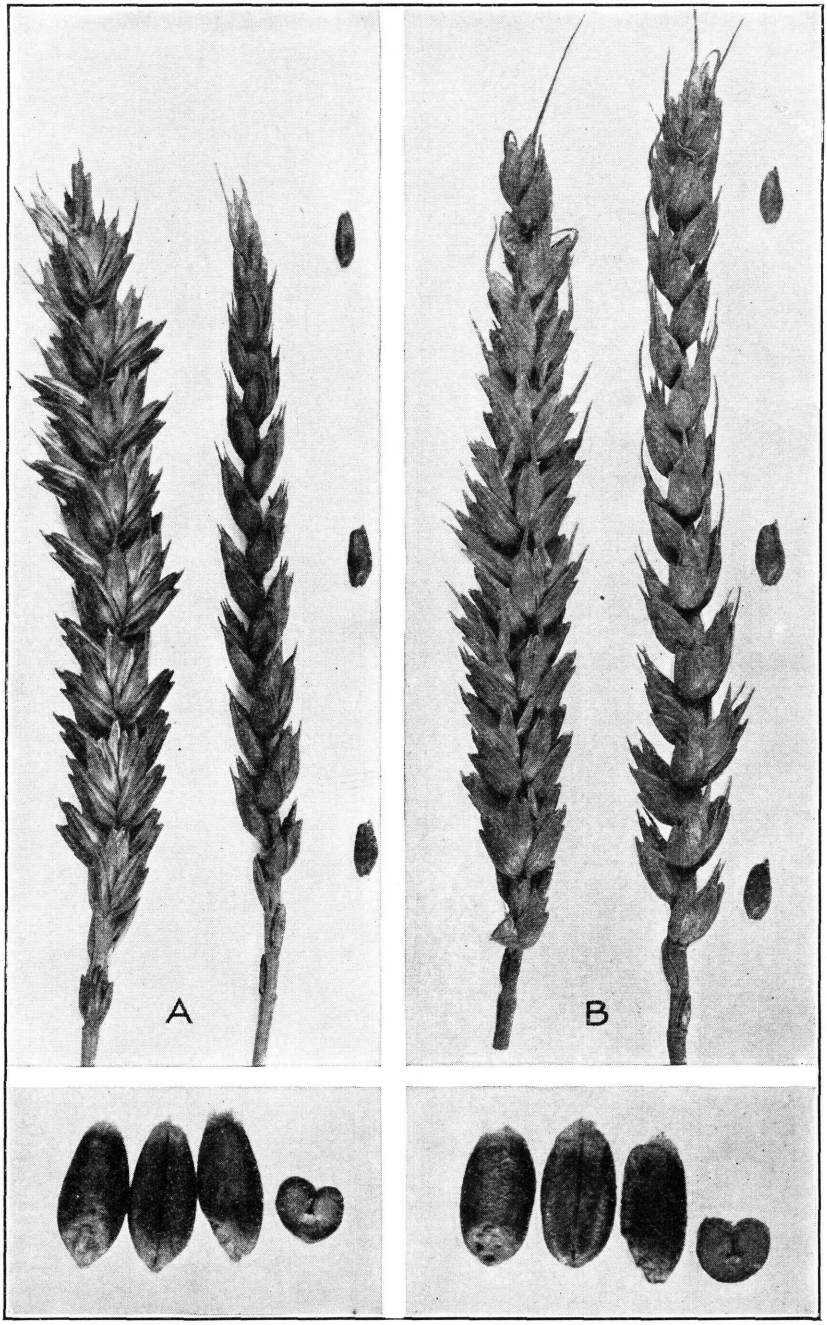

FIGURE 9.—Heads and grain of Leap (*A*) and Purkof (*B*) wheats.

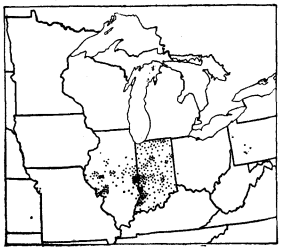

FIGURE 11.—Distribution of Purkof wheat in 1934. Estimated area, 300,357 acres.

The variety is one of the most winter hardy of the soft wheats and no doubt largely for this reason has given relatively high yields. It has been somewhat in disfavor by soft-wheat millers because of its tendency to produce hard or semihard grain.

HARVEST QUEEN

Harvest Queen is a moderately old variety, having been produced from a single plant found in a field of another variety by E. S. Marshall, of De Soto, Kans., in 1895. It was distributed locally by Mr. Marshall and at the present time is grown in northeastern Kansas and in a small area in south-central Kansas and the adjoining portion of Oklahoma, and to some extent in Missouri (fig. 12). It has been grown experimentally farther east, but, in general, has not given satisfactory yields.

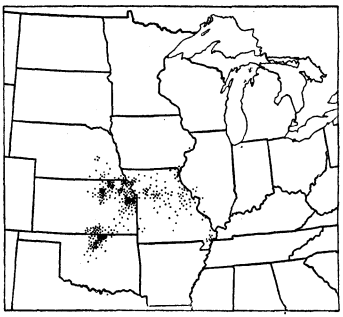

FIGURE 12. — Distribution of Harvest Queen wheat in 1934. Estimated area, 379,897 acres.

This variety is one of the most winter hardy of the commercial soft winter wheats. This in a large measure accounts for its production in northeastern Kansas. It has stiff, strong straw, but nevertheless sometimes lodges owing, no doubt, to the fact that it grows rather tall. The variety is susceptible to flag smut, a disease found in limited areas in eastern Kansas and central Illinois, but strains resistant to this disease have recently been isolated. Heads and grain of this variety are illustrated in figure 13.

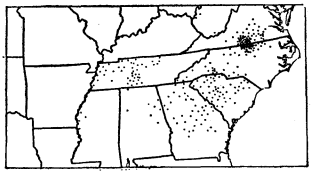

FIGURE 14.—Distribution of Flint wheat in 1934. Estimated area, 178,020 acres.

FLINT

Flint, an old variety of unknown origin, is grown in south-central Virginia and the contiguous area in north-central North Carolina and in South Carolina, and sparingly elsewhere in the southern part of the soft red winter wheat belt (fig. 14). The variety is generally known as Red May, though very different from the variety grown under that name in the North-Central States. (See p. 19 and fig. 20.) The name Early May is also commonly used for this variety. It is about as early in maturity as Purplestraw.

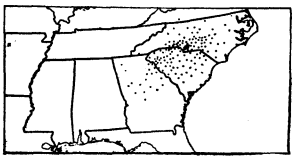

FIGURE 15.—Distribution of Redheart wheat in 1934. Estimated area, 112,392 acres.

REDHART

Redhart is a selection from Flint and is widely grown in North Carolina and South Carolina (fig. 15). It is early and has stiff white straw. The kernels are red and soft. It is less winter hardy than other varieties of winter wheat and should not be grown where winter injury is likely to occur. The variety is recommended for growing in North Carolina and South Carolina.

SOFT RED VARIETIES WITH BEARDLESS HEADS AND GLABROUS BROWN OR RED CHAFF

This group differs from the previous group in having brown or red instead of white or yellow chaff. The heads are smooth and beardless and the kernels red. The leading varieties are Poole, Red Wave, Red May, Currell, and Baldrock.

POOLE

Poole has been one of the important varieties of wheat in Indiana and Ohio for about 50 years and is still grown to a considerable extent, although new varieties in recent years have tended to crowd it out (fig. 16). It has been widely recommended as a high-yielding variety for most of the area that grows soft red winter wheat, but at present is not extensively grown outside of the States mentioned. It appears to be about average in winter hardiness, stiffness of straw, and time of maturity. The beardless heads with brown smooth chaff are wide, flattened, and very nodding (fig. 17, *B*); the straw is purple and of medium height, and the kernels are soft and of

FIGURE 13.—Heads and grain of Harvest Queen wheat.

medium size. In milling and bread-baking quality Poole is considered one of the best of the soft wheats.

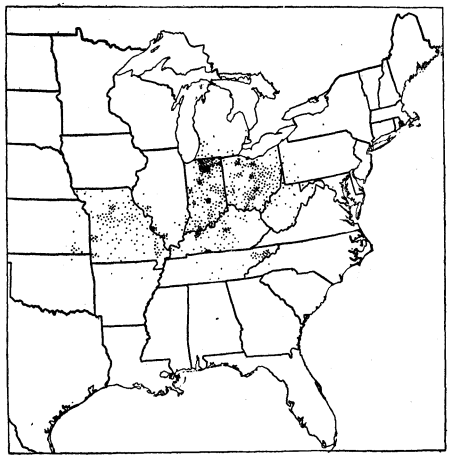

FIGURE 16.—Distribution of Poole wheat in 1934. Estimated area, 672,564 acres.

Poole is grown under a variety of names, including Bluestem, Gill, Harvest King, Kentucky Bluestem, Nissley, Ocean Wave, Red Amber, Red Chaff, Red Fultz, Red King, Red Russell, Royal Red Clawson, Wagner, Winter King, and others. Poole is recommended for Missouri and Indiana.

RED WAVE

Red Wave occupies approximately the same area as Poole (fig. 18). In appearance it is very similar to Poole, except that it has white straw, whereas the latter has purple straw and slightly darker chaff (fig. 19, p. 18). It appears to have somewhat stiffer straw than Poole, but in experimental trials it has been distinctly inferior to most varieties in bread-making quality. Except, possibly, for showing less tendency

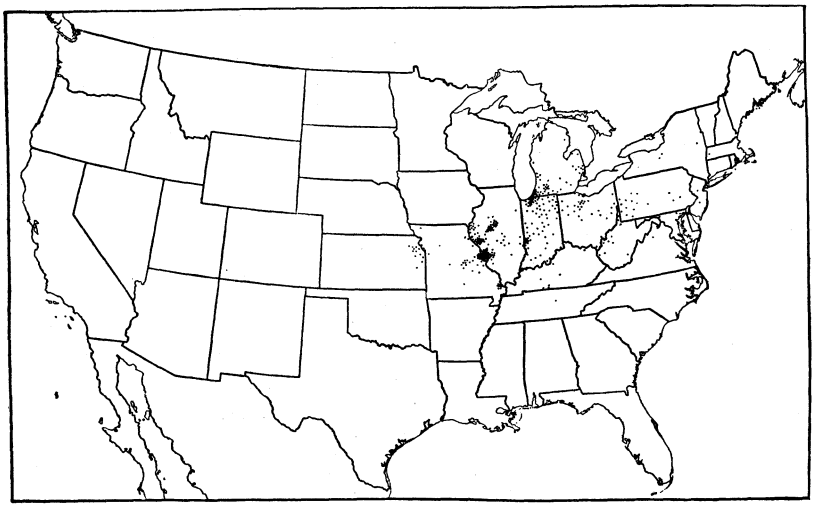

FIGURE 18.—Distribution of Red Wave wheat in 1934. Estimated area, 307,259 acres.

to lodge, Red Wave appears to have no qualities of special merit not possessed by many other varieties of soft wheat. It is not recommended for growing in any State.

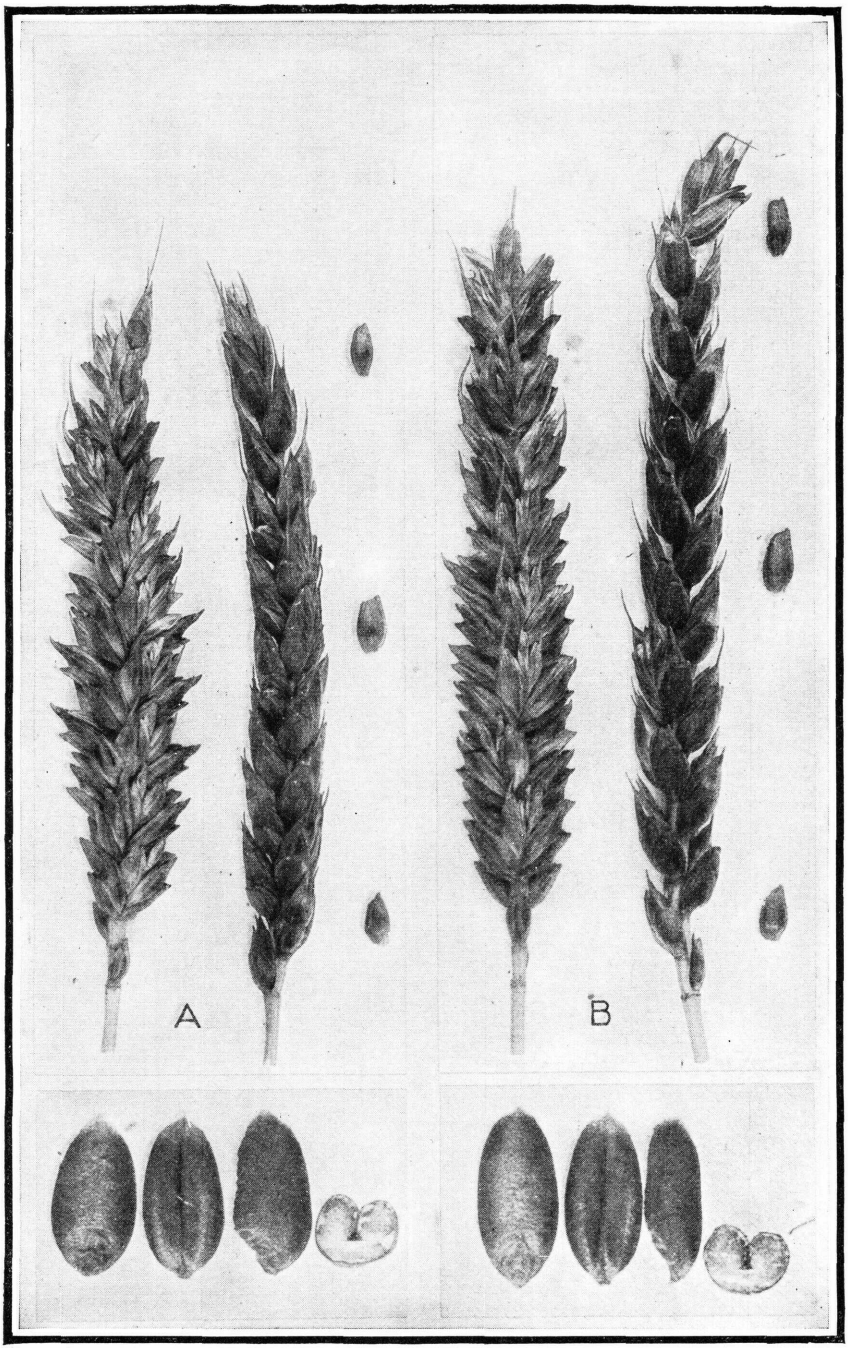

FIGURE 17.—Heads and grain of Currell (*A*) and Poole (*B*) wheats.

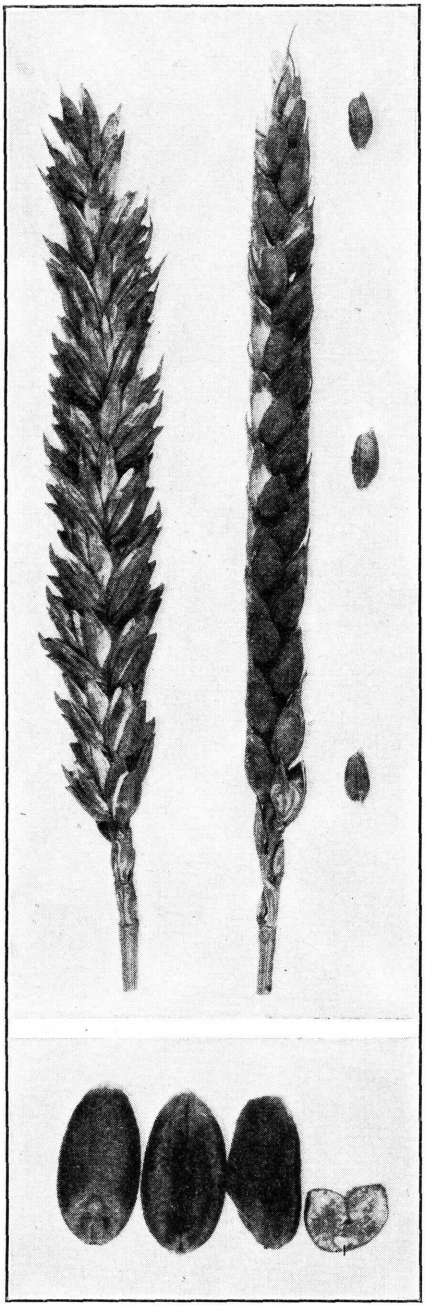

FIGURE 19.—Heads and grain of Red Wave wheat.

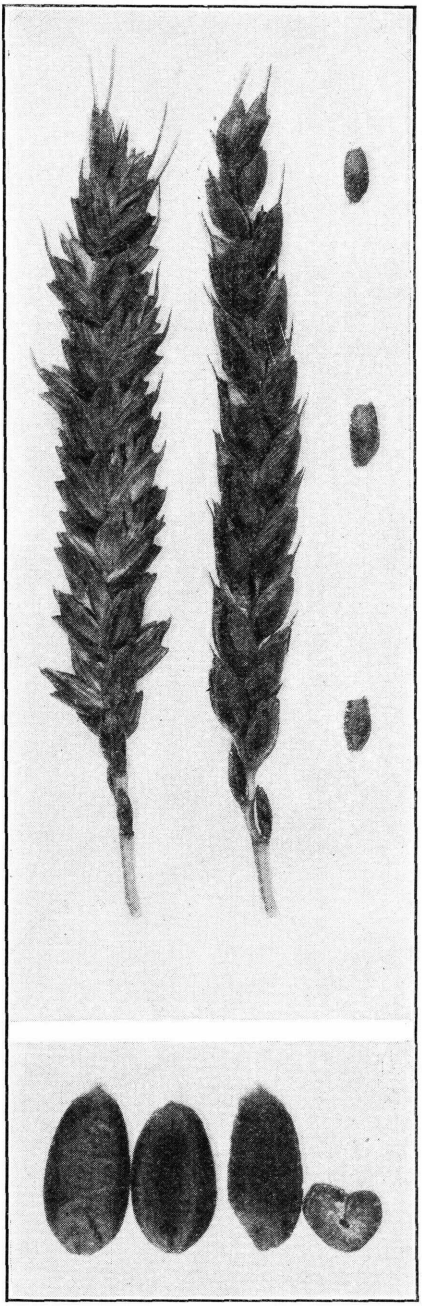

FIGURE 20.—Heads and grain of Red May (Michigan Amber).

RED MAY

Red May (Michigan Amber) is one of the leading varieties in Indiana, being second only to Fultz. It is grown extensively in Illinois as Michigan Amber and in Missouri as Michigan Wonder (fig. 21). The variety has been grown extensively since 1845 as Red May, whereas the names Michigan Amber and Michigan Wonder are of recent origin. The older name is used in the present discussion. It has been grown rather extensively throughout most of the soft red winter wheat area but in recent years has been confined for the most part to Indiana, Illinois, Missouri, and adjoining States. It is earlier than Poole, which it closely resembles in other respects, and is more winter hardy. The appearance of the head and grain is shown in figure 20. Its history has been traced back to the Red Lammas or Yellow Lammas grown in Europe during the seventeenth century. Red May is recommended for growing in Indiana, Illinois, and Missouri.

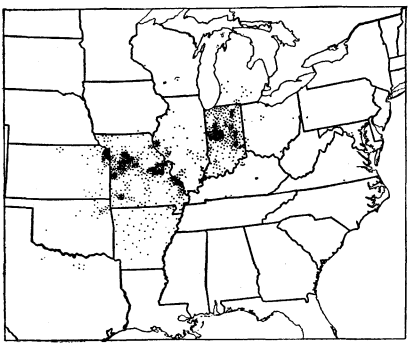

FIGURE 21.—Distribution of Red May (Michigan Amber) wheat in 1934. Estimated area, 977,421 acres.

CURRELL

Currell or Currell Prolific differs from most other varieties of this group in being earlier. It also has rather short straw, which, combined with its stiffness, renders it quite resistant to lodging. The variety is rather widely distributed (fig. 22), especially along the southern border of the soft wheat belt, but is not extensively grown in any area with the exception of southern Kansas, north-central Oklahoma, and southeastern Missouri. Its early maturity, resistance to lodging, satisfactory yield, and excellent quality for pastry flour make it a popular variety in this area. A definite lack of winter hardiness prevents its being grown very far north. The variety is also known as Gill, Golden Chaff, Pearl Prolific, Red Odessa, Red Prolific, and Tennessee Prolific. The heads and grain of this variety are illustrated in figure 17, *A*. Currell is recommended for Maryland and Kentucky. In the latter State it is known as Kentucky 47.

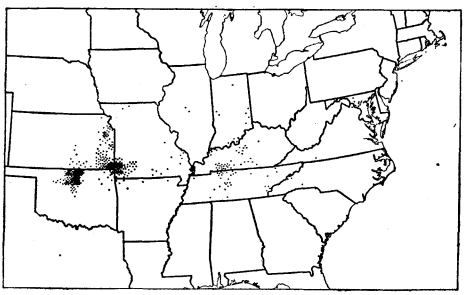

FIGURE 22.—Distribution of Currell wheat in 1934. Estimated area, 480,478 acres.

BALDROCK

Baldrock is a variety produced by the Michigan Agricultural Experiment Station, East Lansing, Mich., from a field hybrid between

Red Rock and some unknown variety. Unlike the known parent, it is beardless. It was first distributed to farmers in 1931. In Michigan it has produced higher yields than other varieties, has stiff straw, and is more winter hardy than Red Rock. It is recommended for Michigan.

SOFT RED VARIETIES WITH BEARDED HEADS AND GLABROUS WHITE OR YELLOW CHAFF

The varieties of this group resemble those of the first group, except that they have bearded heads. The following six varieties and selections of commercial importance are discussed: Fulcaster, Nittany, V. P. I. 131, Mammoth Red, Rudy, and Kawvale.

FULCASTER

Fulcaster is second only to Fultz of all varieties of soft wheat in acreage in the eastern United States (fig. 23). Fultz owes much of its popularity to the fact that it is beardless. Fulcaster, however, is grown chiefly because of its very satisfactory yields, although, other things being equal, farmers prefer a beardless variety. No variety excels it in this respect over so large a territory and under such variable conditions. It is grown especially in the piedmont area from Pennsylvania and northern Maryland, south to North Carolina and Tennessee, but it is also of commercial importance in 25 States included in the region that extends from Kansas and Oklahoma to Delaware and from Michigan to Georgia. Throughout this region, it frequently is found among the highest yielding varieties. Just why this is, has never been explained. Probably its relatively high degree of winter hardiness as compared with that of most soft wheats, its medium-early maturity, a moderate degree of resistance to certain diseases, and perhaps the fact that it is bearded are the principal reasons.

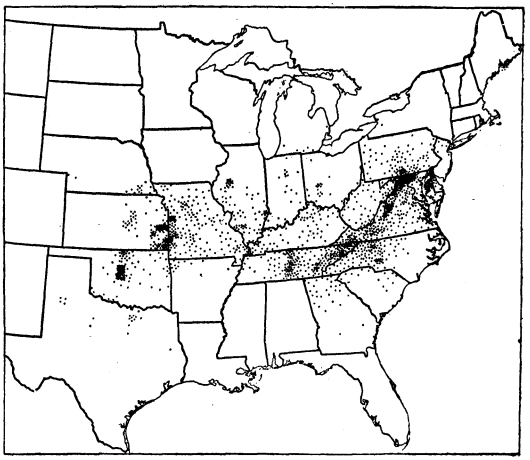

FIGURE 23.—Distribution of Fulcaster wheat in 1934. Estimated area, 1,395,122 acres.

Fulcaster has been grown under a variety of names. A few of the more important in use at the present time are Bearded Bluestem, Bearded Purplestraw, Dietz, Dietz Longberry, Georgia Red, Lancaster, Red Wonder, Stoner, Forty-to-One, Half Bushel, Kentucky Wonder, Marvelous, and Miracle. Several of these names are used also for other varieties of wheat.

Fulcaster is reported to have originated in 1886 from a cross between Fultz and Lancaster (Mediterranean) made by S. M. Schindel, of Hagerstown, Md. In 1884, 2 years prior to the date mentioned above, Dietz Longberry, which is identical with Fulcaster, was ob-

tained from George A. Dietz, of Chambersburg, Pa., by the Ohio Agricultural Experiment Station. The true origin of Fulcaster, therefore, is rather doubtful, but it probably is an older variety than these facts indicate. The variety has been exploited on several occasions by firms who made extravagant claims concerning its ability to produce high yields with a low rate of seeding. Names such as Miracle, One-Peck-to-the-Acre, and Millennium were thus applied to certain strains of Fulcaster. It is now known that Fulcaster and strains of this type should be sown at the same rate as other varieties.

FIGURE 24.—Heads of Fulcaster, the leading bearded wheat of the eastern United States.

Fulcaster has rather large, bearded, tapering, inclined heads and white chaff with brownish-yellow stripes (fig. 24). The beaks (points on the outer chaff) are less than one-third of an inch in length. The plants are of medium height and maturity. The kernels are moderately large, usually somewhat angular and soft, but, when grown in dry seasons or in dry climates, they are rather hard, approaching in hardness those of hard wheats.

In milling and baking quality for bread, Fulcaster ranks with the better varieties of soft red winter wheat. Under favorable but dry conditions in Kansas, Texas, and Oklahoma it is nearly equal in quality to hard red winter varieties for bread. Fulcaster is a recommended variety for North Carolina, Tennessee, Virginia, West Virginia, Illinois, Missouri, Oklahoma, Kansas, Kentucky, Georgia, and Arkansas.

NITTANY

Nittany is a selection from Fulcaster made at the Pennsylvania Agricultural Experiment Station and was first distributed to farmers in 1918. It is taller, ripens several days later, and under favorable conditions will produce somewhat larger yields than the parent. However, it is somewhat more inclined to lodge on rich land than is the parent variety. It is grown especially in Pennsylvania and Delaware (fig. 25).

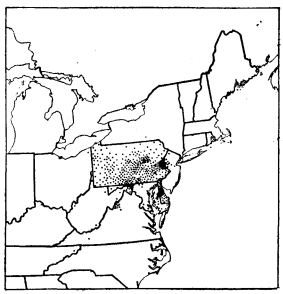

FIGURE 25.—Distribution of Nittany wheat in 1934. Estimated area, 409,223 acres.

V. P. I. 131

V. P. I. 131 is a selection from Fulcaster made by the Virginia Agricultural Experiment Station. It is the third most important variety in Virginia, being exceeded in acreage only by Fulcaster and Leap. It has been reported from Tennessee, North Carolina, and West Virginia, but is not grown extensively in those States (fig. 26). It closely resembles Fulcaster in appearance and growth. It is especially recommended for growing in Virginia.

MAMMOTH RED

The history of Mammoth Red extends back to the early nineties, when it was distributed by a seed company in Dallas, Tex., and presumably was grown in Texas. At the present time it is scarcely grown, except on the Eastern Shore of Maryland and in adjacent Delaware, where it has become an important variety in the past 10 years. The variety is very similar to Fulcaster but matures later, and the kernels are somewhat larger and harder.

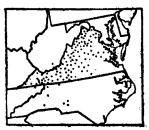

FIGURE 26.—Distribution of V. P. I. 131 wheat in 1934. Estimated area, 106,292 acres.

RUDY

Rudy is also one of the older varieties of wheat, the importance of which has been declining in recent years. It was originated at Troy, Ohio, in 1871 and was a leading variety in the Ohio River Valley for many years. Its present acreage probably is less than half of what it was 15 years ago. It is grown and recommended chiefly in Indiana (fig. 27). The variety usually can be distinguished from others of this group by the yellowish-white chaff with black-striped margins.

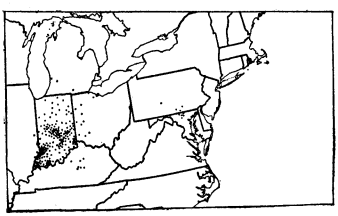

FIGURE 27.—Distribution of Rudy wheat in 1934. Estimated area, 211,991 acres.

KAWVALE

Kawvale was developed at the Kansas Agricultural Experiment Station as a selection from an old variety known as Indiana Swamp. It was released for distribution to Kansas farmers in 1932. The variety is resistant to winter injury as compared with other soft wheats and is unusual in being highly resistant to certain strains or varieties of hessian fly.

It is also resistant to leaf rust. It matures early and gives high yields. Unfortunately, the grain shatters easily and cannot be allowed to stand in the field after it is ripe. While the variety is classed as soft red winter, the grain usually can better be described as semihard. It is recommended in Kansas.

SOFT RED VARIETIES WITH BEARDED HEADS AND GLABROUS BROWN OR RED CHAFF

Only three varieties of commercial importance are included in this group. They are Mediterranean, Denton, and Red Rock.

MEDITERRANEAN

Mediterranean is grown chiefly in north-central Texas but is widely, though sparingly, grown throughout the eastern United States (fig. 28). For some unknown reason it has rapidly declined in importance in the past few years, its acreage in 1934 being less than 20 percent of what it was 5 years earlier. It is among the highest-yielding varieties in the humid portions of Texas and Oklahoma and also in southeastern Kansas, where it has been grown as Red Sea. Its comparative resistance to leaf rust is a valuable characteristic in this area. This variety has long, tapering, bearded, brown-chaffed heads and very long, soft red kernels (fig. 29, *A*). The plants are tall, mature in midseason, and have purple straw. It is one of the heaviest straw producers of the soft red wheats and is subject to lodging.

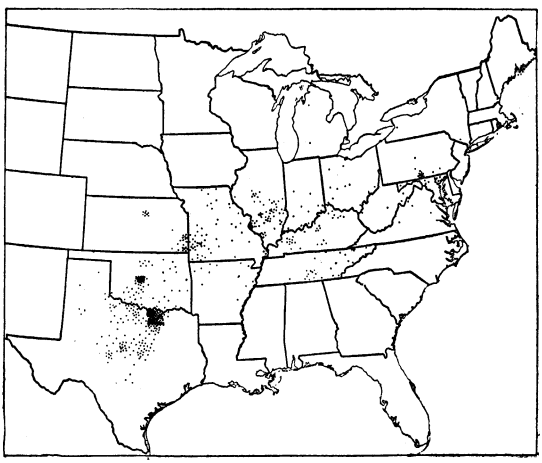

FIGURE 28.—Distribution of Mediterranean wheat in 1934. Estimated area, 519,261 acres.

The most authentic history of the Mediterranean variety indicates that it was introduced from Genoa, Italy, in 1819, by John Gordon, of Wilmington, Del. During the next 30 or 40 years it spread westward to Missouri, Kansas, Oklahoma, and Texas. It is recommended for Texas and Illinois, where it is known as Red Sea, and for Arkansas.

Mediterranean is also known as Acme, Bluestem, Farmers Trust, Great Western, Key's Prolific, Lancaster Red, Lehigh, Miller, Miller's Pride, Missouri Bluestem, Mortgage Lifter, Redchaff, Red Sea, Red Top, Rocky Mountain, Standby, and Swamp.

DENTON

Denton is a tall, white-strawed selection from Mediterranean made at the Texas Agricultural Substation No. 6, Denton, Tex. It was distributed to Texas farmers in 1926 and has since attained consid-

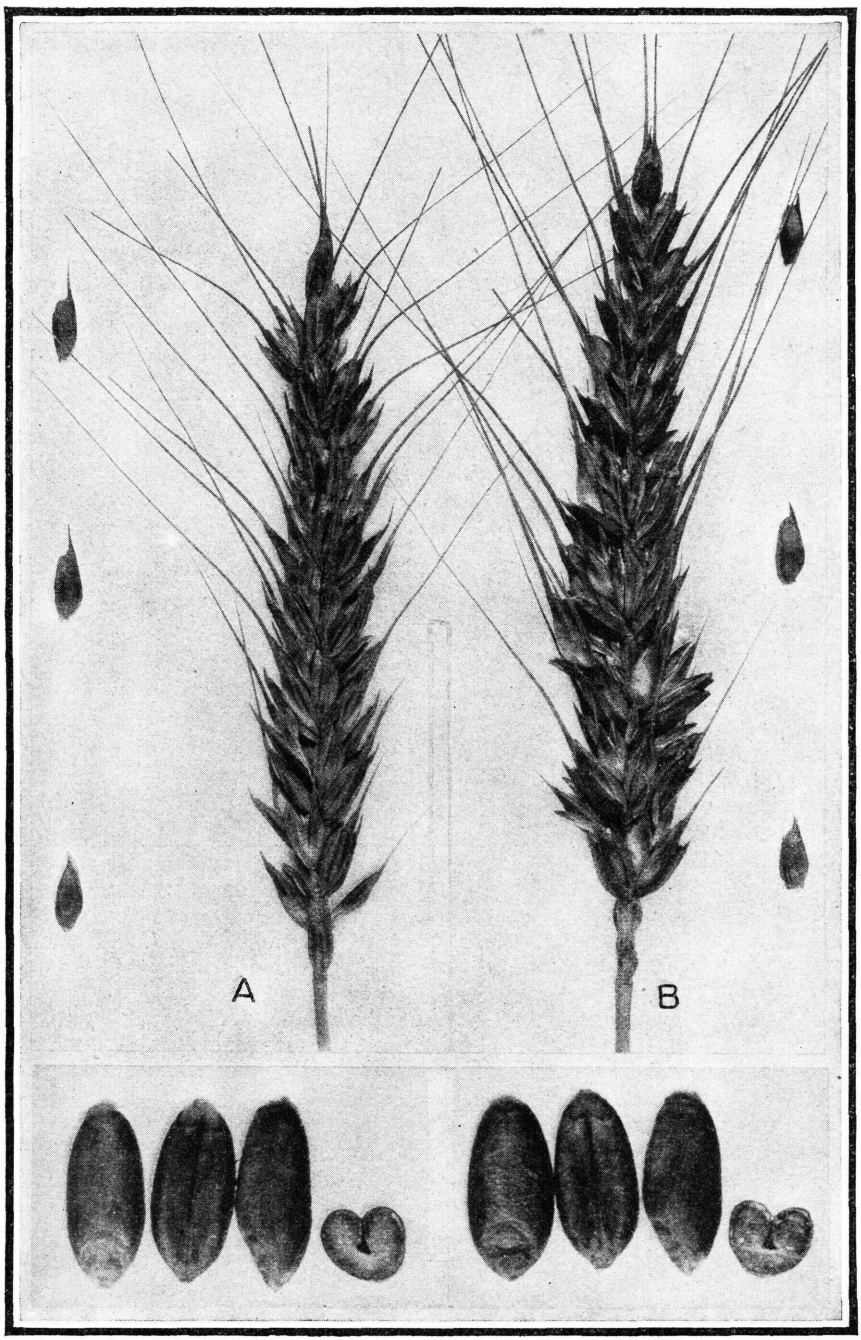

FIGURE 29.—Heads and grain of Mediterranean (*A*) and Red Rock (*B*) wheats.

erable prominence in north-central Texas. It matures early, is resistant to leaf rust, produces high yields, and is less likely to lodge than the parent. Denton is recommended for Texas and Oklahoma.

RED ROCK

Red Rock was originated from a single head found in Goldcoin (Plymouth Rock), a white wheat, at the Michigan station in 1907. It is very similar to Mediterranean (fig. 29) and probably was present in the Goldcoin as a mixture. The heads are somewhat larger and more open than those of Mediterranean, and the kernels are harder. It is grown principally in Michigan, where it is the leading variety of soft red wheat (fig. 30). In this State it is prized especially for the quality of the grain for bread. This appears to be largely because of its higher protein content as compared with the soft white wheat usually grown in that State. Relatively high yields and unusually stiff straw, which is shorter than that of Mediterranean, have made it a popular variety on Michigan farms. It is relatively nonwinter hardy and should not be grown where winter-killing is likely to be important. Red Rock is recommended for Michigan.

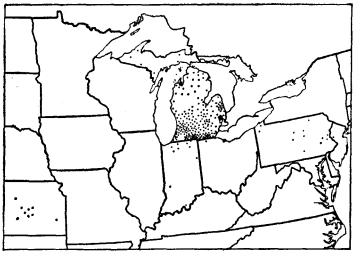

FIGURE 30.—Distribution of Red Rock wheat in 1934. Estimated area, 219,706 acres.

SOFT WHITE WINTER WHEAT

This group includes all varieties of soft winter wheat of commercial importance in the eastern United States having white grain. The varieties discussed are Goldcoin, Dawson, and Honor.

GOLDCOIN

Goldcoin (Fortyfold) is one of the leading varieties of white wheat in the United States, over 400,000 acres having been grown in 1934 (fig. 31). In the eastern United States it is an important variety in Michigan, New York, and Ohio. It has excellent straw and does not lodge easily. Also it produces an excellent pastry flour, and the grain is highly prized for breakfast cereals prepared from whole wheat. An increased demand for the latter purpose probably is one reason for the present acreage.

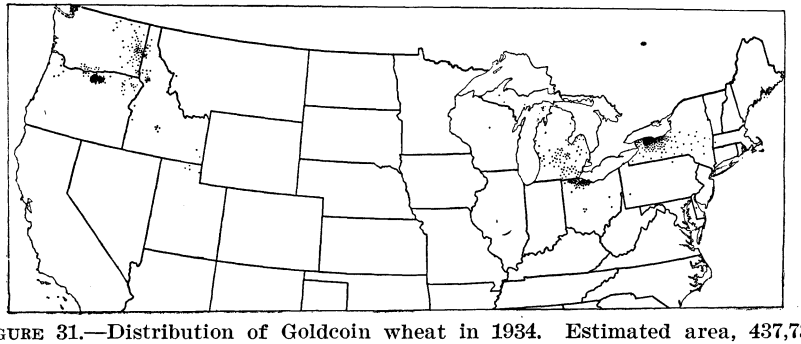

FIGURE 31.—Distribution of Goldcoin wheat in 1934. Estimated area, 437,734 acres.

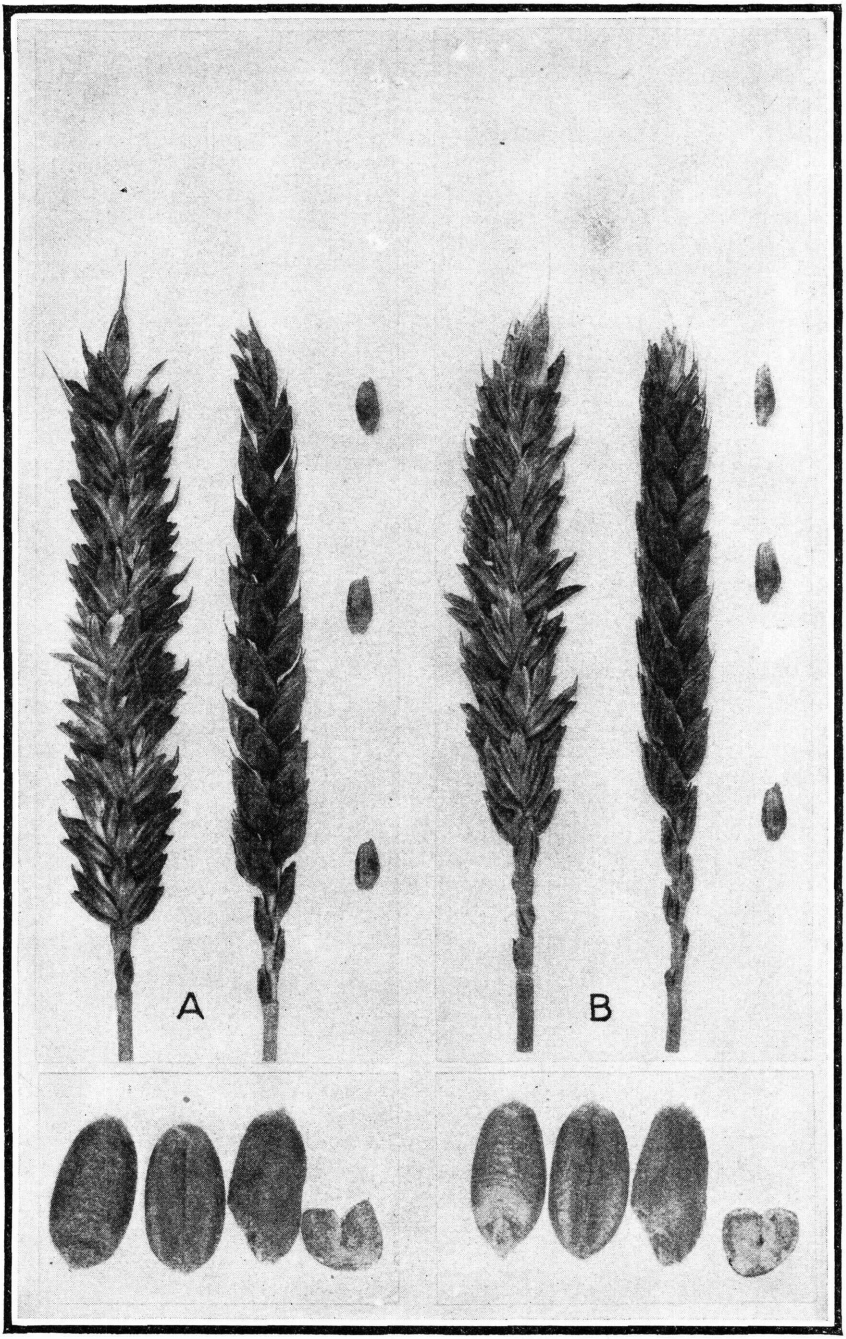

FIGURE 32.—Heads and grain of Dawson (*A*) and Goldcoin (*B*) wheats.

Several conflicting stories respecting the origin of Goldcoin and its various strains have been announced. The New Soules wheat identical with Goldcoin has been known since 1840. Clawson or White Clawson, also identical with Goldcoin, is claimed to have originated in Seneca County, N. Y., in 1865 by selection from a field of Fultz. It is also supposed to be a descendant of a variety grown in the Genesee Valley of New York as early as 1798 and known as Redchaff. The particular strain to which the name Goldcoin was first applied originated from a head found in a field of Diehl-Mediterranean wheat by Ira M. Green, of Avon, N. Y.

Goldcoin wheat has erect, compact heads which have a golden brown chaff. The heads usually are distinctly clubbed at the tip (fig. 32, *B*). The straws or stems are purplish or reddish at maturity. The kernels are midsized, soft, and white. Most of the kernels have a rim or collar around the brush (tuft of hairs at the tip). This feature is often useful in distinguishing the variety from Dawson. The kernels are rather easily shattered from the heads at maturity.

The Goldcoin variety is known by many names, including Abundance, Clawson, Eldorado, Fortyfold, Gold Bullion, Golden Chaff, Gold Medal, Goldmine, Improved No. 6, International No. 6, Junior No. 6, Klondike, New American Banner, New Soules, Niagara No. 6, Oregon Goldmine, Plymouth Rock, Prizetaker, Prizewinner, Rochester No. 6, Soules, Superlative, Twentieth Century, White Century, White Clawson, White Eldorado, White Rock, White Russian, White Soules, White Surprise, and Winter King. In the Western States it is almost universally known as Fortyfold. Some of the names listed above are for supposedly selected strains, but none of them can be distinguished from the parent variety. The variety is recommended for growing in New York, where it is usually known as Junior No. 6, and in Michigan.

DAWSON

Dawson (American Banner) ranks second only to Goldcoin in importance of the white wheats of the eastern United States. It is of commercial importance only in Michigan and New York (fig. 33). The variety differs from Goldcoin chiefly in having white or yellow instead of purple straw and in having an oblong instead of a clubbed head (fig. 32, *A*). Also the kernels do not have the collar or rim around the brush as do those of Goldcoin.

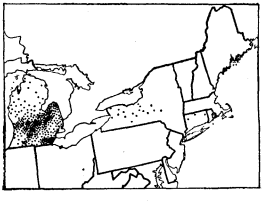

FIGURE 33.—Distribution of Dawson wheat in 1934. Estimated area, 356,108 acres.

With the possible exception of Honor, Dawson is the most winter hardy of the white wheats, though less so than some of the soft red winter wheats. Possibly partly for this reason, it has produced excellent yields in the northeastern United States. In this area it is seldom outyielded by other varieties. Like Goldcoin, it produces a flour that is very satisfactory for pastries or for prepared cereals, although generally inferior for bread.

The Dawson variety was originated from a plant found in a field of Clawson wheat in 1881 by Robert Dawson, of Paris, Ontario, Canada. After it was found to be a high-yielding variety at the Ontario Agricultural Experiment Station, the acreage was rapidly increased. Dawson is recommended in Michigan, where it is known as American Banner, and also in New Jersey.

HONOR

Honor cannot be distinguished from the Dawson variety by any easily observed morphological character. It is slightly hardier, has a stronger straw, and in New York produces better yields than Dawson. It was selected from Dawson at the Cornell (New York) University Agricultural Experiment Station. After trials lasting several years at the station and on farms in New York it was offered for sale in 1920. It is now grown and recommended in that State.

VARIETIES OF HARD RED WINTER WHEAT

As has been pointed out (p. 41), some hard red winter wheat is grown in certain portions of the eastern United States, especially in northern Illinois, northwestern Indiana, southern Wisconsin, and southern Minnesota, and Iowa.

Varieties of this group are grown in the East primarily or exclusively because of their ability to survive cold winters. As compared with those of varieties of soft wheat, yields are high in hot, dry seasons and in those following severe winters in which damage occurs. In wet seasons the hard wheat varieties are likely to lodge and produce low yields. Also the grain that is produced is semihard and usually has a mottled appearance known as yellow berry. Hard red winter wheat is not so satisfactory for bread as the grain of similar varieties from the Great Plains nor as suitable for pastry flour as the true soft wheats. In the extreme eastern United States, where winter injury is mainly due to heaving, the hard red winter wheats often do not survive so well as the soft wheat. For this and other reasons they are not grown in this area.

The leading varieties are Turkey, Kanred, Iobred, Michikof, and Minturki. Turkey is by far the most important. This variety was first introduced into central Kansas by Mennonite colonists who brought seed with them from their former home in Russia. Kanred is a selection from a strain of Turkey made by the Kansas Agricultural Experiment Station. Both varieties have bearded heads, smooth white chaff, and relatively small red grain. The straw is rather weak, and consequently is likely to lodge on very fertile land or in wet seasons.

Ilred, a selection from Turkey, made at the Illinois Agricultural Experiment Station, has been grown to a considerable extent in that State. It differs from Turkey in no important respect but in experimental trials in Illinois has yielded somewhat better.

Iobred, a selection from Banat, made at the Iowa Agricultural Experiment Station, differs from other hard red varieties in having brown chaff and beards and a short, plump kernel very similar to that of Marquis spring wheat. In Iowa it is relatively winter hardy, has strong, stiff straw, and yields relatively well. It is grown extensively in northeastern Kansas and sparingly in Illinois. The

grain shatters rather easily; hence the crop should not be permitted to stand long after it is ripe.

Michikof was produced by the Agricultural Experiment Station of Purdue University to meet the demand for a variety that would produce relatively hard, high protein grain for the semihumid Indiana climate. The effort was in part successful, but in the meantime the market situation had changed to such a degree that Michikof is often discriminated against on eastern markets because of its hard grain. The variety is relatively winter hardy and is grown quite extensively in Indiana and in central Illinois largely for this reason (fig. 34). It was produced by crossing Red May (Michigan Amber) and Malakof, the latter a hard winter wheat similar to Turkey. It is the only hard red winter variety of commercial importance in the eastern United States that is awnless.

Minturki is the most winter hardy of any variety of winter wheat grown on a commercial scale. It is somewhat resistant to stem rust and bunt. It was produced at the Minnesota Agricultural Experiment Station from a cross between Odessa, a very winter hardy soft wheat, and Turkey. Because of its winter hardiness it has given good yields in southern Minnesota and northern Illinois. The grain is somewhat softer than that of Turkey and contains a rather high content of the yellow pigment known as carotene, which imparts a yellow color to the flour. For the latter reason, Minturki flour may require more bleaching than flour from other hard winter wheat.

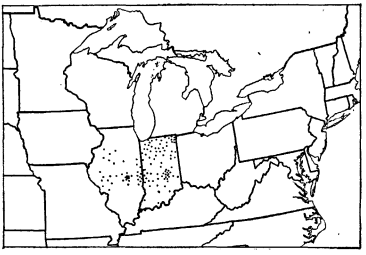

FIGURE 34.—Distribution of Michikof wheat in 1934. Estimated area, 91,923 acres.

VARIETIES OF SPRING WHEAT

Spring wheat is not grown extensively in the eastern United States. It is, however, of considerable importance locally in northern Illinois and southern Wisconsin, and a few thousand acres are usually grown in northern New York, Pennsylvania, and Ohio. A million acres of spring wheat was grown in the eastern United States, principally Illinois and Iowa, soon after the World War, but the acreage has since declined to less than 10 percent of this amount. Only four varieties are of commercial importance, viz, Marquis, Java, Progress, and Preston.

Marquis is the leading variety of spring wheat in the eastern United States. It was produced in Canada from a cross between Hard Red Calcutta, an early Indian wheat, and Red Fife. It is noted, especially, for the quality of grain it produces. In the eastern United States it is grown principally in Illinois and Iowa, but it is also found in New York, Maine, and Indiana.

It is a beardless variety with smooth, white chaff, short, plump red grain, and a relatively short, stiff straw that seldom lodges. It is less susceptible to bunt than most other varieties of spring wheat, but very susceptible to stem rust, by which it may be severely injured if the attack gets started early.

The name Java is used for several strains, all of which are bearded and have red grain but vary in color of chaff from white to brown and in grain texture from soft to hard. The most common type has white smooth chaff and soft kernels. It probably is one of the oldest varieties of spring wheat in the United States. A similar or identical variety was grown as Siberian in New York as early as 1837 and in Virginia as early as 1849. Java is now grown principally in Illinois and Iowa, where its early maturity and resistance to scab appear to be the principal reasons for its production. Illinois No. 1, a selection from Java, is grown to some extent in Illinois.

Progress is a selection from Java made at the Marshfield (Wis.) Branch Agricultural Experiment Station. It is more resistant to rust and in Wisconsin is a better yielder than the parent. It matures considerably earlier than Marquis, which also is an advantage in this area. It is perhaps the most resistant to scab of any variety of wheat but produces flour which is poor for bread in comparison with that from most other varieties of spring wheat. It is grown chiefly in southern Wisconsin.

Preston, at one time an important variety of spring wheat, is grown to a limited extent in Illinois and Iowa. It appears to have no outstanding characteristics that commend it above those already described. It is a bearded variety with smooth, white chaff and rather slender, red grain similar to that of hard red winter.

NEW VARIETIES OF SOFT WINTER WHEAT

In recent years a number of new varieties of soft winter wheat have been released for distribution to farmers. Not a great deal is known regarding their adaptation or their value outside of the States where they were originated.

Clarkan probably is the result of a cross between Blackhull and Harvest Queen. It was selected by Earl G. Clark, a farmer living near Sedgwick, Kans. It was first distributed to Kansas farmers in 1934 and is now recommended by the Kansas Agricultural Experiment Station for eastern Kansas. The variety has large, soft, red grain and a very stiff straw, and in Kansas has given very satisfactory yields.

Leapland is a selection from Leap made by the Maryland Agricultural Experiment Station. It is very similar in appearance to Leap but in Maryland has given higher yields.

The designation V. P. I. 112 has been given to a selection similar to Poole made by the Virginia Agricultural Experiment Station. It is recommended for the higher upland soils of that State.

Valprize is the result of a cross between Valley and Grandprize made by the New York (Cornell) Agricultural Experiment Station and recently distributed to farmers of that State. It has very soft, light-red kernels which produce a flour of excellent pastry quality.

Canawa was selected by the West Virginia Agricultural Experiment Station from a badly mixed variety known as Canadian Hybrid. The characteristics of the new variety suggest that its immediate parent may have been a natural cross between Red May and Jones Fife. It has beardless nodding heads, smooth white glumes, or chaff, and semihard, short red kernels. In cooperative

tests with farmers in West Virginia it produced better yields than other varieties with which it was compared.

Thorne, a beardless, brown-chaff variety with soft red grain, was developed at the Ohio Agricultural Experiment Station from a cross between Portage and Fulcaster and distributed in the fall of 1937. It is resistant to the races of loose smut present in Ohio and to mosaic. It is more resistant to lodging and has given higher yields than Trumbull in Ohio.

Wabash, a beardless, white-chaff variety, was selected from a plot of Fultz at the Purdue University Agricultural Experiment Station, because of its high degree of resistance to leaf rust. It is quite different from the parent variety, however, and is undoubtedly the result of a natural hybrid. It has been a high-yielding variety in Indiana and Illinois and was approved for distribution in those States in the fall of 1938. It is resistant to leaf rust and mosaic but susceptible to flag smut.

Purdue No. 1, a beardless variety with red chaff, was developed at the Purdue University Agricultural Experiment Station from a cross between Michigan Amber and Rudy. It was first grown on farms in 1934. Purdue No. 1 is somewhat resistant to leaf rust but susceptible to mosaic and to loose and flag smuts. It has given high yields in Indiana.

Illinois No. 2, a bearded variety with brown chaff and soft short red grain, is a selection from Indiana Swamp (Valley) made at the Illinois Agricultural Experiment Station in 1915. It was distributed in the fall of 1932. It is winter hardy and somewhat resistant to leaf and stem rust. It is, however, susceptible to the mosaic disease and to flag smut.

Brill is the best of 6,000 head selections from Turkey made at the Illinois Agricultural Experiment Station in 1922. It was distributed in Illinois in the fall of 1936. Brill is bearded and has light brown chaff; its hard red grain is resistant to yellowberry. This variety is winter hardy and somewhat resistant to flag smut, leaf rust, and scab. It is, however, susceptible to mosaic.

Early Premium was selected from a farmer's field of "May" wheat (probably Rice or Zimmerman) by the Missouri Agricultural Experiment Station and was distributed to farmers in the fall of 1937. It is a very early variety with soft red grain, a beardless head, and white chaff. Because of its early maturity, it is recommended by the Missouri station for growing especially when lespedeza is sown in the wheat crop or when wheat is to be followed by a summer crop such as soybeans. Its early maturity also enables it to escape stem rust in some years.

Yorkwin is a selection from a cross between Dietz (Fulcaster) and Goldcoin made in 1919 at the Cornell University Agricultural Experiment Station. It is a beardless, white-chaff variety with soft white kernels and is a high-yielding variety in New York State. It was distributed to farmers in 1935.

GROWING WINTER WHEAT

Many factors are involved in successfully growing a crop of wheat. Only the more important ones are considered here.

ROTATIONS

It is not advisable or profitable to grow wheat continuously on the same land in the eastern United States. Wheat fits well in the crop rotations ordinarily used in this region.

WHEAT ROTATIONS FOR THE CORN BELT

A good wheat rotation contains at least one legume and one or more cultivated or row crops. In the Corn Belt these requirements are easily met with corn and clover. Seeding with wheat serves as a convenient and inexpensive means of obtaining a stand of clover, as the preparation of the ground for wheat suffices also for clover. As a nurse crop, wheat shades the ground less and is harvested earlier than oats and usually is more profitable than rye. Inasmuch as cattle are commonly raised on most farms, the growing of wheat is an advantage, since it is of value for pasture, feed, and bedding.

The fact that wheat is well suited as a nurse crop for clover or grasses, whether alone or in combination, means that it should occupy a place in the rotation preceding them. Where corn can be grown successfully, it makes better use of the improved productivity of the land brought about by growing clover and grass than most any other crop. Corn, therefore, is usually grown following these crops.

Oats, sometimes, can be sown conveniently after corn and harvested early enough to provide plenty of time to prepare the land for a following crop of wheat. Thus a natural and efficient rotation for much of the eastern United States is wheat 1 year, clover and timothy 1 or 2 years, corn 1 year, and oats 1 year. Ordinarily, the clover and timothy or as much of the clover as is left after the first winter, is grown 2 years. On very rich soil corn may be grown 2 years successively, thus increasing the length of the rotation and the acreage of the corn crop.

Cowpeas or soybeans may be substituted very profitably for oats in many localities where oats do not pay, or wheat may be grown 2 years in succession. In tobacco-growing localities, tobacco may be grown in place of the oats. Barley may occasionally be substituted for oats, but spring barley is not a very satisfactory crop on poor soil or in localities where scab or chinch bugs are likely to be prevalent, as in Illinois, Iowa, and Missouri.

In recent years it has been found that wheat often is more profitable after soybeans or cowpeas than after corn; hence, when these crops are grown, the rotation may well be corn, cowpeas or soybeans, wheat, and clover, each 1 year. Such a rotation is especially satisfactory if the cowpeas or soybeans are to be cut for hay. In any case all that is necessary to prepare the land for wheat is a thorough disking, or even this may be dispensed with if the ground is loose and mellow as is frequently the case.

Some good rotations or cropping systems for the central and northern parts of the region are as follows:

Rotation No. 1: Corn; wheat; clover.
Rotation No. 2: Corn; wheat (clover and grass seeded with wheat); clover and grass 2 years.
Rotation No. 3: Corn 2 years; wheat; red clover or sweetclover.
Rotation No. 4: Corn; oats, soybeans, or cowpeas; wheat; clover.
Rotation No. 5: Wheat; clover and timothy 1 or 2 years; corn; oats.

Lespedeza is becoming a popular crop in those areas where it can be grown, especially where an important objective is to improve the soil or prevent damage from erosion. The lespedeza seed is sown (usually broadcast) early in the spring on the fall-sown wheat, and, after wheat harvest, may be pastured or permitted to make a crop of hay or seed. If wheat is to be seeded again, the land is prepared by disking. As the lespedeza reseeds itself, the wheat-lespedeza rotation may be grown continuously. To be fully successful an early variety of wheat must be used.

Some of the more common rotations including wheat and lespedeza are:

Rotation No. 1: Corn; wheat, lespedeza for pasture, hay, or seed; wheat.
Rotation No. 2: Corn; wheat, lespedeza for pasture, hay, or seed; lespedeza.
Rotation No. 3: Corn; wheat, lespedeza for pasture, hay, or seed.
Rotation No. 4: Corn; soybeans; wheat, lespedeza for pasture, hay, or seed.
Rotation No. 5: Wheat; lespedeza for pasture, hay, or seed; lespedeza for pasture, hay, or seed.

Where wheat immediately follows corn, as in rotations 1, 2, and 3, the corn is cut and shocked or put into the silo, thus permitting the regular seeding operation, or the wheat is seeded between the standing rows of corn with a narrow one-horse drill. In many sections wheat also is sown between the rows of corn shocks.

WHEAT ROTATIONS FOR THE COTTON BELT

In the southern part of the region, somewhat different rotations are preferable because of the longer growing season, the different type of soil, and the fact that cotton is the leading crop. Because of the late maturity of cotton, wheat cannot be grown immediately after this crop. Usually, therefore, if cotton is included in the rotation, it is followed by corn. The following rotations including wheat have been found satisfactory:

Rotation No. 1: Wheat, followed by cowpeas or soybeans for hay or seed; cotton, well-fertilized, with vetch or Austrian winter peas planted between the rows for green manure; corn, stalks cut and removed from the field.
Rotation No. 2: Wheat, followed by cowpeas or Otootan soybeans for hay or seed; corn and velvetbeans; Laredo soybeans planted early and cut for hay.
Rotation No. 3: Corn, crimson clover at last cultivation; soybeans or cowpeas; wheat (clover and grass seeded with wheat in the spring); clover and grass 2 years.

FERTILIZERS AND MANURE

Commercial fertilizers and manure may be used to good advantage in growing the wheat crop. The best fertilizer or fertilizer combination to use on wheat or in a rotation containing it depends largely on the productivity of the soil. This productivity is related to the nature of the soil and to its previous treatment. Usually the State agricultural experiment stations have fertilizer experiments on the

different soil types and are prepared to make specific recommendations. A limited quantity of commercial fertilizer applied to the wheat crop usually pays on the soils of the eastern United States.

Soils of the eastern United States, except the dark-colored soils of the prairies and of low-lying, imperfectly drained areas, commonly lack nitrogen. When the wheat plants have light-green foliage it is usually an indication of a shortage of available nitrogen. The nitrogen deficiency usually can be most economically corrected by plowing under crops of legumes, such as red clover, sweetclover, cowpeas, or soybeans. However, it is sometimes desirable to supplement this supply with commercial nitrogen or even to depend on the latter exclusively. Nitrate of soda or sulphate of ammonia are commonly used for this purpose. A common practice is to apply them broadcast on the surface of the ground early in the spring at the rate of about 100 pounds per acre.

Phosphorus is more generally used for wheat than any other commercial fertilizer in the eastern United States. It is largely supplied in the form of superphosphate or rock phosphate. The application is usually made either just before or at the time of seeding. From 200 to 300 pounds of superphosphate per acre are commonly used.

Potash should be applied to soils of low fertility, especially sandy soils on the Coastal Plain. On clay or loam soils, the application of potash usually does not pay.

A complete commercial fertilizer is one in which all three of the most frequently deficient plant foods, nitrogen, phosphorus, and potash, are present. Mixed fertilizers are usually satisfactory, but definite recommendations as to formulae and amounts should be obtained from the State experiment stations. One of the fertilizers commonly used for wheat is 200 to 300 pounds of a 2–12–6—i. e., 2 percent of nitrogen, 12 percent of phosphorus, and 6 percent of potash. A fertilizer of approximately this ratio is often used on sandy soils. For loam and clay soils the nitrogen may be omitted and the phosphorus increased, giving a 0–14–6 content. The nitrogen should be omitted if lodging is at all frequent. Also, if manure is used in the rotation, the nitrogen may be left out unless the soil is in a very poor state of productivity.

When the soil is acid, an application of lime—either the ground limestone or air-slaked lime—is beneficial. Wheat itself is not injured by a slightly acid soil, but most legumes grown in the rotation will be decidedly benefited by the use of lime.

Manure is a valuable fertilizer for wheat, but usually it is best applied to the corn crop when the latter is in the rotation. On both light sandy soils and heavy clay soils, well-rotted manure plowed under supplies the humus necessary to improve the physical condition of the soil and also adds valuable nutrients, particularly nitrogen and potash. The manure may be applied before seeding or as a top dressing to the wheat in late fall or early winter. Four or more tons to the acre are recommended, the heavier rates of application on the lighter soils.

PREPARING THE LAND

The time and method of preparing the land for wheat depends principally on the crop which precedes it. As a rule, it is desirable to have the land prepared considerably in advance of seeding to per-

mit settling and the accumulation of moisture and available plant food, especially nitrates. When the land is to be plowed, as after a small-grain crop, at least a month should intervene between plowing and seeding. The land should be plowed, preferably, immediately after harvest, since otherwise weeds and volunteer grain will grow and rob the soil of moisture and nitrates that should be conserved for the following crop. The soil can be most easily and much better prepared when it is in proper friable condition. This often occurs soon after harvest. After the ground dries out it is likely to turn up cloddy and lumpy and will be difficult to work into a good seedbed. If for any reason plowing must be delayed, disking the ground immediately after harvest is beneficial. After plowing, the ground should be worked with disk and harrow, as necessary, to keep weeds and volunteer grain under control and get it in condition for seeding. Figure 35 illustrates a method of working the ground into condition for wheat.

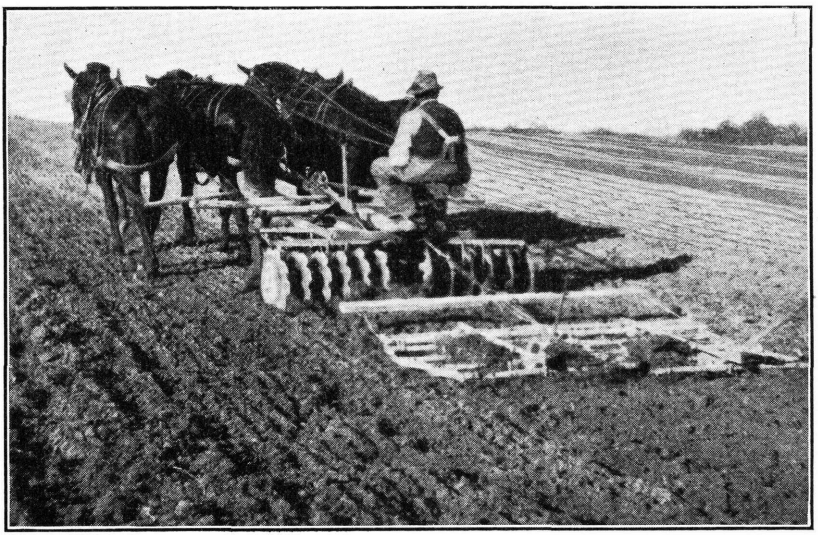

FIGURE 35.—Disking and harrowing the ground for wheat in one operation.

The depth of plowing should be governed to a considerable extent by the quantity of stubble, weeds, and cover crop to be turned under, and should be sufficient to do this thoroughly. Also, the plow may be run somewhat deeper if plowing is done early rather than late. A common practice is to plow 6 to 7 inches deep in July and early August, gradually decreasing the depth to 4 to 5 inches in late August and September. Ordinarily there is no advantage in plowing deeper than is here indicated.

Much of the acreage of wheat in the eastern United States follows corn or soybeans in the rotation. Usually, in such cases the time of harvesting and the condition of the land after the crop is removed determine the preparation of the ground for wheat. Corn in this area is often cut and shocked in the field to be husked later. Under such conditions preparing the ground with a disk or a spring-tooth harrow is a common practice. Soybeans often leave the ground free

from weeds, friable, and in good condition for seeding with no preparation whatever or only by disking and harrowing.

SEED

Wheat, unlike corn, is normally self-pollinated, and for this reason an adapted variety will change very slowly, if at all, because of the locality in which it is grown. However, in such old varieties as Fultz and Fulcaster there are strains differing from each other, especially in productivity. Accordingly, it is usually preferable to obtain locally seed of the variety one wishes to grow. Once a suitable variety has been obtained, maintaining good seed requires roguing (removing other grain mixtures) of the plants in that part of the field desired to be harvested for seed. It usually is best to thresh the seed bundles after threshing the main crop to lessen the chance for mixing in the threshing machine.

Weed seeds, smut balls, and broken and small kernels should be removed with the fanning mill. If the wheat has a heavy infesta-

FIGURE 36.—A disk drill in operation.

tion of bunt (stinking smut), is moldy, or shows signs of having sprouted, it should not be used for seed. Seed not too heavily infested with bunt may be used if treated as directed on page 43.

Sound wheat that has been stored in a dry bin ordinarily germinates satisfactorily. However, if it has been wet or there is any other reason to suspect that its vitality has been injured, it should not be used, unless a germination test is made. It should not be used if it germinates less than 90 percent. Wheat, 1, 2, or even 3 years old, may be used for seed if it germinates satisfactorily. Seed older than this is likely to be weak.

SEEDING

In the early history of this country wheat was sown broadcast for want of satisfactory machinery, but at present winter wheat is almost universally sown with a drill (fig. 36). Drilling saves seed, insures

better germination, reduces winter injury, and almost always produces better yields. Drills are of three general types: Hoe, shoe, and single- and double-disk drills. Single-disk drills are most commonly used. Hoe drills are satisfactory only on clean land and have some advantages on stony land. Drills with rows 6 to 8 inches apart are generally the most satisfactory.

Winter wheat in the eastern United States is usually sown at the rate of from 5 to 8 pecks per acre. Usually 6 pecks or more per acre will produce larger yields than a lesser quantity. The Ohio Agricultural Experiment Station has conducted extensive tests with various rates of seeding with a number of varieties for a period of 17 years. On an average, 8 pecks per acre gave the most profitable yields. Seeding at 6 and 7 pecks per acre was only slightly inferior. Heavier seeding than usual is ordinarily advisable if seeding is delayed beyond the normal date, since there is less opportunity for the plants to stool.

Certain varieties have been advertised as having the ability to stool more than others and requiring less seed per acre. This claim, in general, is unfounded. Varieties do differ in their ability to stool, but all recommended varieties, if seeded at the proper time and under favorable conditions, will tiller sufficiently to enable the plants to fully occupy the land.

There is no advantage in seeding wheat deeper than necessary to insure sufficient moisture for good germination. In light soils the seed may be safely sown deeper than in heavy soils. Covering the seed from 1 to 1½ inches is usually sufficient.

Wheat should be sown early enough to become well established before winter, but not so early that it makes a rank growth or starts to shoot before winter, nor early enough to become infested with hessian fly if this insect is prevalent. Usually this means early enough to permit tillering so that the wheat will cover the ground reasonably well. Unless wheat is grown for pasture, there is seldom any advantage from very early seeding, and there is considerable danger from lodging, winter-killing, and the hessian fly.

When the hessian fly is prevalent, it is advisable to delay fall seeding until the safe date, which is the earliest date in the fall at which wheat can be seeded and still, with average conditions, escape damage from the hessian fly. These dates have been established experimentally and, of course, vary for different parts of the country. Safe average dates for seeding are indicated in Farmers' Bulletin 1627, but as the actual dates may vary from year to year, wheat growers are advised to consult their State agricultural experiment stations or county agents regarding the best seeding date for specific counties or areas for any given year.

On well-prepared land in the average season, the safe date is early enough to permit a satisfactory growth of wheat before winter and maximum yields. On the other hand, it is as late as can safely be recommended. For this reason and because of possible delays due to bad weather, it is usually advisable, when the hessian fly is not present, to start seeding approximately a week or 10 days earlier than the recommended safe dates.

PASTURING

Wheat is a highly nutritive pasture crop, and when the pasturing is done with judgment no injury to the grain crop results. It should be remembered, however, that the plants should be well established before pasturing begins; otherwise, the plants may be uprooted by animals while grazing. This date will depend upon the growing season. Livestock should be kept off during wet weather. If grass or clover has been sown with the wheat, injury is likely to be especially severe, if the wheat is pastured when the land is muddy. Spring pasturing may be practiced under favorable conditions, but a loss in grain yield should be expected. The loss is likely to be especially heavy if pasturing is permitted after the plants begin to shoot, which usually takes place a few weeks after growth starts. Excessive pasturing at any time of the year is likely to reduce yields.

MULCHING AND CULTIVATING

An application of straw, not exceeding 2 tons per acre, applied as a top dressing in the late fall or early winter is sometimes recommended as a means of decreasing winter injury. Without doubt, the straw is beneficial in this respect, but in nearly all cases where it has been tried it reduces the yields in seasons when no winter injury occurs. Also a mulch of wheat straw from the preceding crop may be an important source of insect pests such as the hessian fly, strawworm, and jointworm. Mulched wheat is often yellow in the spring, indicating that the straw reduces the supply of available nitrates in the soil. The Ohio Agricultural Experiment Station recommends 1 to 2 tons of straw per acre on unmanured light-colored soils low in productivity where winter-killing is likely to occur. It should be spread uniformly in late November or December.

Rolling wheat in the spring with a corrugated roller is sometimes beneficial as, for example, when the soil is badly cracked or the wheat plants have been heaved by alternate freezing and thawing. Except in such cases neither rolling nor harrowing is likely to pay. To be beneficial, rolling must be done as soon as growth starts in the spring but should not be practiced when the top soil is wet.

HARVESTING

Wheat in the eastern United States is largely harvested with the grain binder. During the past 10 years the use of the combine harvester, commonly called the combine, has come into some favor. With this machine the grain is cut and threshed at one operation.

The principal advantages are the opportunity to harvest and thresh promptly while the weather is favorable, and to save labor. Objections are that the grain cannot be harvested until it is fully ripe or overripe, thus increasing the risk from storm damage and the danger of spoilage in the bin, which almost inevitably results when damp or slightly immature grain is put into a tight bin in large quantities. Also in the eastern United States the acreage of wheat on individual farms is not usually sufficient to warrant so heavy an investment in harvesting machinery. Another serious objection on many farms is that, with the combine, the straw is scattered over the land instead of being preserved in a stack or the mow for feed and bedding. In the eastern United States the objections usually outweigh the advantages, except on large grain farms.

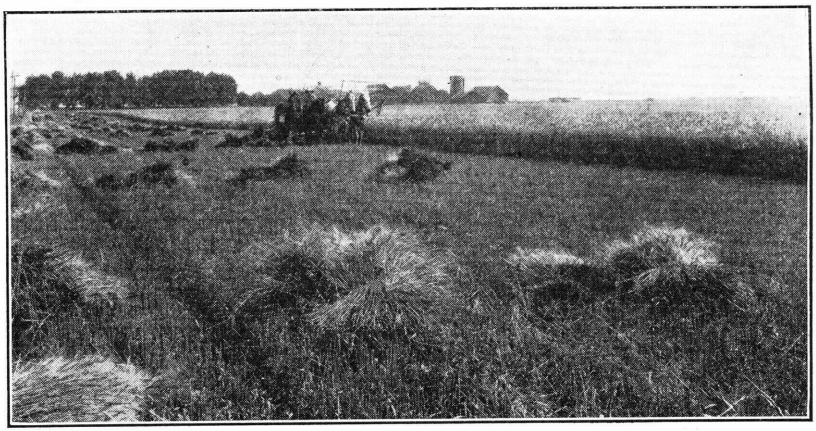

FIGURE 37.—Harvesting a field of soft winter wheat in La Salle County, Ill.

Where the wheat is to be harvested with the binder, the crop is ready when the straw is well-colored, either purple or yellow, and the grain is in what is known as the hard-dough stage. A harvesting scene is shown in figure 37.

SHOCKING

Immediately after being cut with a binder, the wheat should be shocked (fig. 38). A well-built shock saves considerable grain loss in wet weather. The shock should be large enough to avoid being blown over by winds but not large enough to cause molding of the heads. Usually 12 or more bundles form a shock. The first two bundles should be set upright firmly on the ground with the heads well together. The remaining bundles are set firmly in the stubble around these two. The shock is completed by capping it with two bundles the stalks of which have been bent down at the band.

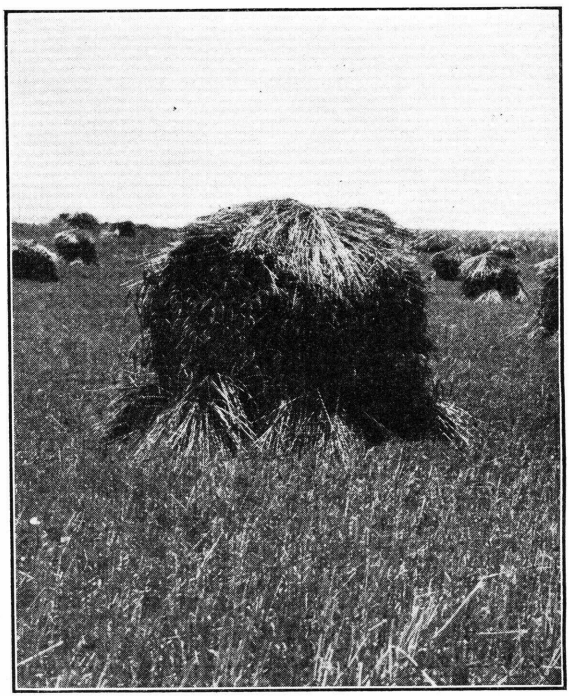

FIGURE 38.—A shock of wheat.

Storing wheat in the barn or stacking it in the barnyard is occasionally practiced. The advantages in either case are that

the grain is protected from the weather and that threshing may be done at a more convenient time. The principal disadvantage is the additional labor expense because of the extra handling.

THRESHING

The majority of farms in the eastern United States depend on custom threshing. This means that the interval between cutting and threshing may be several weeks. Well-shocked wheat will, however, be little injured by ordinary weather, and it is the more common practice to thresh direct from the shock rather than to stack the grain or store it in barns. The latter is still done, however.

In sections where the Angoumois grain moth is prevalent, it is especially desirable to thresh as soon as the grain is dry enough to store, or severe losses in grain may result. In these sections the use of storage bins, thorough cleaning of these bins before storage of the new crop, and fumigation of the grain immediately after storage are advisable.

Wheat should not be threshed when the straw is tough or the grain wet. It is much easier to dry the grain before threshing rather than after.

The straw is commonly stacked in the open and used for roughage and bedding for stock during the winter. Ultimately it should find its way back to the soil. Close to cities or poultry sections, wheat straw can often be baled and sold at a profit.

GROWING SPRING WHEAT

As indicated on page 29, a small acreage of spring wheat is grown in Iowa, northern Illinois, and southeastern Wisconsin; only a little is grown in New York, Pennsylvania, and Ohio. Spring wheat receives attention especially when, for any reason, winter wheat cannot be seeded or is killed during the winter. Also, under reasonably favorable conditions, spring wheat may prove more profitable than oats and is often considered a very satisfactory nurse crop for grass and small legumes.

Usually spring wheat occupies the same place in the rotation as oats—that is, after corn. Both corn and wheat harbor the fungus (*Gibberella saubinetii* (Mont.) Sacc.) which causes scab, and since the fungus spores live through the winter on old cornstalks and are disseminated by the wind in the spring, there is serious danger of scab infection in spring wheat if the cornstalks are not removed or plowed under. Since early seeding is desirable, it is a good plan to plow in the fall. However, a thorough disking and harrowing in the spring will prove reasonably satisfactory if fall plowing is not done. It is especially important that spring wheat be seeded as early in the spring as the ground can be prepared. In a 5-year test at the Illinois Agricultural Experiment Station, in which spring wheat was sown at 10-day intervals beginning as early in the spring as possible, there was a progressive decrease in yield in the later seedings. For the earliest seedings, the average date of which was March 6, the average yield was 25.7 bushels, as compared with only 16.2 bushels for seeding at what is considered the normal date (April 5) for seeding spring small grains.

Spring wheat may be seeded with a drill or sown broadcast, as with an endgate seeder. The former produces larger yields and is to be preferred, other things being equal. Sometimes, however, seeding can be done earlier if the broadcast method is used, and frequently the gain from the early seeding will more than offset the loss as compared with drilling. The broadcast method also is more rapid and less expensive, except that more seed may be required. Both methods are used.

The rate of seeding is usually higher for spring than for winter wheat. The Illinois station recommends approximately 2 bushels per acre.

DISEASES OF WHEAT

Rusts, smuts, and scab are the most common and most destructive diseases of wheat in the eastern United States. Others, such as take-all, septoria, mosaic, and nematode disease, may in some years cause important local losses. With the exception of the rusts and septoria, these can be controlled, at least to a reasonable degree.

In addition to these there are a number of diseases, mostly of lesser importance, for which no satisfactory control measures are known. Some of these are helminthosporium leaf spot and foot rot, anthracnose, powdery mildew, ergot, black chaff, and basal glume rot.

RUSTS

Two important diseases of wheat in the eastern United States are stem rust and leaf rust; the first is so called because it attacks the stems of the plants principally and the second because it attacks the leaves principally. Both are due to small parasitic fungi the spores of which are carried by the wind to the wheat plant, there to develop at the expense of the wheat.

It was not until about 200 years ago that anything of importance was known regarding the nature or cause of rust. The Romans attributed the periodic ravages to a special rust god, Robigus, who resorted to this means of wreaking his vengeance on a wicked people. According to another belief, the rust was due solely to the weather. It is now known that there must be favorable weather for the development of the fungus and also that spores must be present.

Of the two kinds of rust, stem rust is by far the most destructive, and the effects are more conspicuous, since it causes badly shriveled kernels and in a very few days may reduce the yield to a fraction of what would otherwise be secured. Fortunately, it does not occur in damaging amounts generally in the eastern United States, although it has been known to cause severe losses in some years.

Leaf rust is present nearly every year and is widespread. It reduces the number and size of kernels and the yield and the protein content of the grain. The effect is not conspicuous, however, and usually passes unnoticed. In the aggregate the losses no doubt are heavy.

Neither leaf rust nor stem rust can be prevented by seed treatment, nor indeed by any kind of treatment that is practical after the plants once become infected. Destruction of certain kinds of barberry plants on which the stem rust fungus lives during a part of the year, is known to be beneficial in reducing losses from this disease. Aside

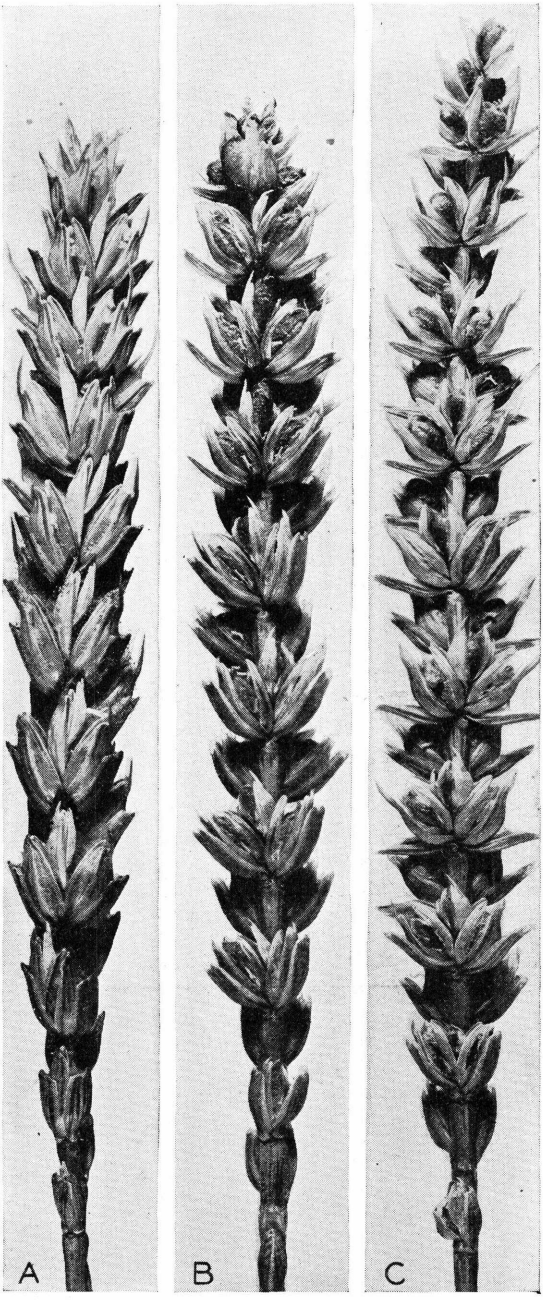

FIGURE 39.—Harvest Queen wheat: *A*, Sound head; *B* and *C*, bunted heads.

from this, the only practical means of avoiding losses is to grow resistant varieties or those that are able to escape damage because of their early maturity.

There are at present no varieties of wheat well adapted to the eastern United States that are highly resistant to stem rust and none that are highly resistant to all races of leaf rust. Hence the farmer can scarcely expect to entirely avoid losses from these diseases. The varieties recommended elsewhere in this publication are either moderately resistant to stem rust and leaf rust, or mature early and thereby escape severe damage, or have other desirable characteristics of sufficient importance to overbalance their susceptibility. The use of these varieties, therefore, is recommended until such time as resistant varieties, satisfactory in other respects, are available.

SMUTS

There are two important kinds of smut of wheat in the eastern United States: Stinking smut, or bunt, and loose smut. Flag smut also occurs in limited areas. Loose smut can be distinguished by the fact that black spores replace both the grain and the chaff and are blown away by the wind before harvest, leaving the bare central

stem (rachis) of the head. Stinking smut, or bunt, on the other hand, replaces the grain only with balls of spores, leaving the outer coat of the kernel and also the chaff intact. As its name implies, it can be distinguished also by its characteristic fetid odor. The stinking smut, or bunt, is the more important of the two. It not only reduces the yield but also lowers the quality and the market value of the grain. Flag smut attacks the leaves only and can be distinguished from the others by that fact. It may seriously reduce the yield under conditions favorable for the smut.

BUNT, OR STINKING SMUT

Bunt, or stinking smut, is carried over from one crop to the next as black spores on the seed or as smut balls mixed with the seed. When bunt-infested seed is sown under favorable conditions, such as in moist, cool soil, the smut spores germinate, and the fungi penetrate into and infect the young seedlings. As the infected plants grow, the smut fungi grow within them and produce what are commonly called smut balls instead of kernels in the heads. When the wheat is ripe, the presence of these smut balls is made evident by the odor and the appearance of the smutted heads (fig. 39). The smut balls are grayish brown or almost black and are about the size and shape of the wheat kernels (fig. 40, p. 44). When crushed in the fingers, the smut balls are found to be filled with foul-smelling smut dust—the spores of the causal fungus. Most wheat growers are familiar with smut balls as they are threshed with wheat and with the foul-smelling odor as it comes from the machine. Badly smutted wheat must be washed or "scoured" before milling to remove both the smut spores and the odor. Because of this, smutty wheat is discounted on the market.

There are no varieties of wheat commonly grown in the eastern United States that are resistant to all strains of smuts, although some varieties are more resistant than others. Therefore, seed treatment, for the present, must be relied upon for control.

Very badly smutted wheat should not be used for seed. Moderately smutted seed can be safely used if thoroughly cleaned in a good fanning mill and then well dusted with copper carbonate, New Improved Ceresan, or basic copper sulphate before being sown, as described on page 45. Formaldehyde also may be used, but it is likely to injure the germination of the seed.

SEED TREATMENTS FOR BUNT

The most widely used seed treatments for stinking smut, or bunt, in winter wheat are the copper carbonate dust treatment and the ethyl mercury phosphate dust treatment (New Improved Ceresan). Either of these is satisfactory in the eastern United States, where soil infestation does not occur, provided that the seed wheat has been thoroughly cleaned before treatment and was not too heavily smutted to begin with. Wheat that is black with smut spores is unsuitable for seed. All the smut balls should be removed before the seed is treated.

Experiments have shown that basic copper sulphate, a promising seed-treatment compound lately placed on the market, is equal to copper carbonate for controlling stinking smut.

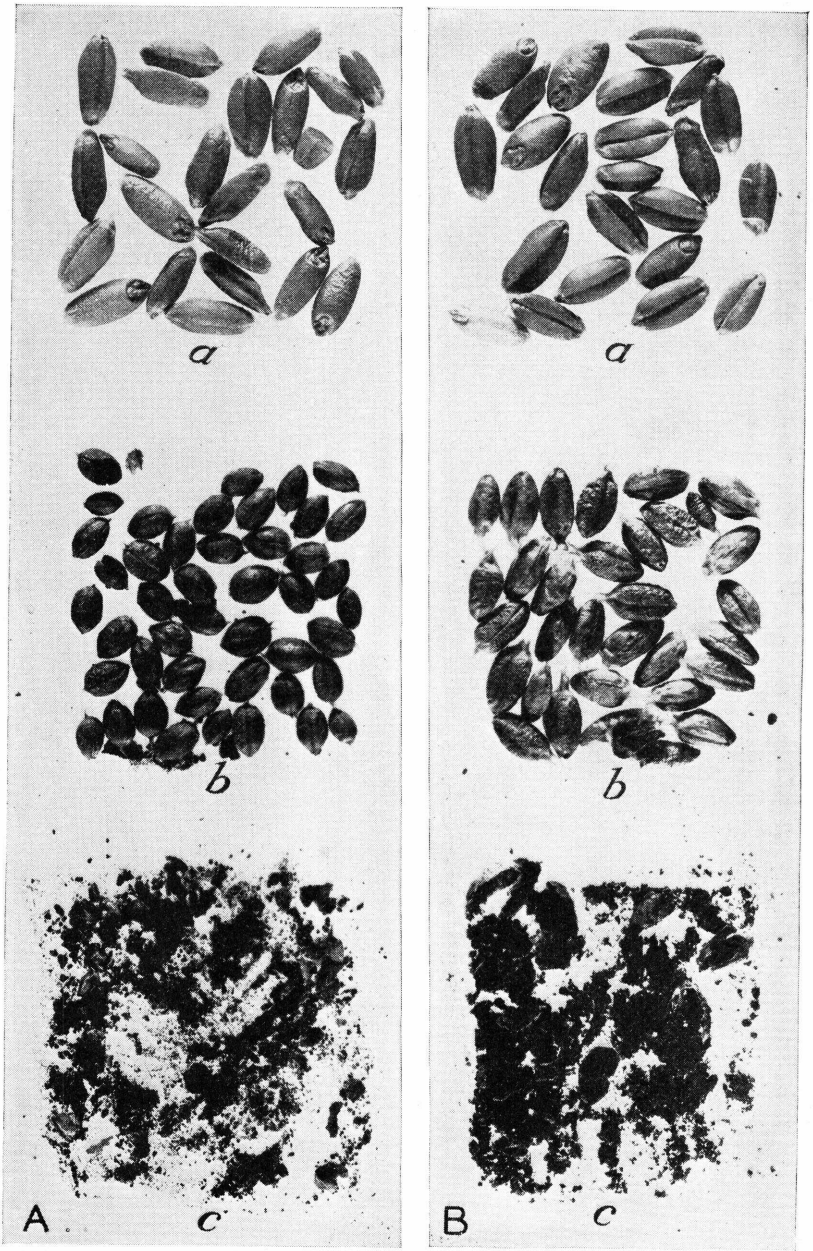

FIGURE 40.—*A*, Stinking smut on Kanred wheat: *a*, Wheat grains; *b*, smut balls; *c*, smut spores. *B*, Stinking smut on Harvest Queen wheat: *a*, Wheat grains; *b*, smut balls; *c*, smut spores.

These seed treatment compounds may be purchased at drug stores, seed houses, or other places where seed and similar products are for sale.

COPPER CARBONATE DUST TREATMENT

A full-strength copper carbonate dust (about 50-percent copper), manufactured especially for seed treatment, should be applied at the rate of 2 to 2½ ounces per bushel of well-cleaned seed. The seed and the dust should be mixed in a tight mixing machine until every kernel is thoroughly covered. Seed thus treated may be stored indefinitely, without injury to germination. With this chemical, care must be used to avoid damage to the grain drill. Sometimes there is a tendency for the treated seed to cake in the drill when standing overnight or longer in damp or wet weather. In such cases it is advisable to rock the drill wheels back and forth before starting, in order to avoid breaking or bending the working parts. All working parts of the drill should be kept well oiled. The treated grain should be well cleaned out of the drill when seeding is completed to avoid corrosion of the parts. Seed treated with copper carbonate should not be fed to farm animals.

ETHYL MERCURY PHOSPHATE DUST TREATMENT (NEW IMPROVED CERESAN)

Ethyl mercury phosphate dust, manufactured especially for seed treatment, should be applied at the rate of one-half ounce per bushel in a mixing machine, or as recommended in directions on the container. The dusted grain should be kept in a bin, pile, wagon box, or sacks for at least 10 hours. During this period the grain should remain uncovered. Treated grain may then be seeded at once, or it may be stored for not longer than 4 weeks. Ordinarily grain should not be treated more than 4 weeks before seeding because of uncertainty as to the effect on seed germination after this period. This treatment has the advantage of being applicable to wheat, oats, and barley, is easily applied, does not cake in the drill, and is noncorrosive to drill parts. As in the case of copper carbonate, seed treated with this chemical should not be fed to farm animals. Do not apply more than one-half ounce of this disinfectant per bushel of wheat. An excess may injure germination.

BASIC COPPER SULPHATE DUST TREATMENT

Basic copper sulphate dust (about 50-percent copper), manufactured especially for seed treatment, should be applied at the rate of 2 to 2½ ounces per bushel of well-cleaned seed, and mixed as outlined above for the copper carbonate treatment.

Caution.—Copper carbonate, ethyl mercury phosphate (New Improved Ceresan), and basic sulphate dusts are POISONOUS. Therefore, the inhaling of these compounds should be avoided. Treat seed in a well-ventilated place or outdoors. Wear a dry cloth or a dust mask over the nose and mouth. Avoid taking New Improved Ceresan in the hands or letting it otherwise contact the moist skin as it may cause blistering. Handle it in special spoons provided for the purpose, and handle Ceresan-treated grain in tight bags.

SEED-TREATING EQUIPMENT

Equipment for applying dusts to seed grain ranges all the way from home-made hand mixers (figs. 41, 42) operating at the rate of 25 to 30 bushels an hour to commercial, automatic power-driven, and gravity-type mixers, handling 200 to 500 bushels per hour. A grav-

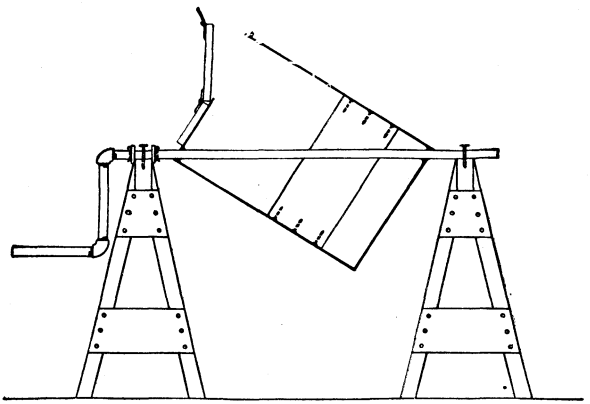

FIGURE 41.—An oil-drum mixer for treating seed wheat with copper-carbonate dusts. (Designed by R. S. Kirby, Pennsylvania State College.)

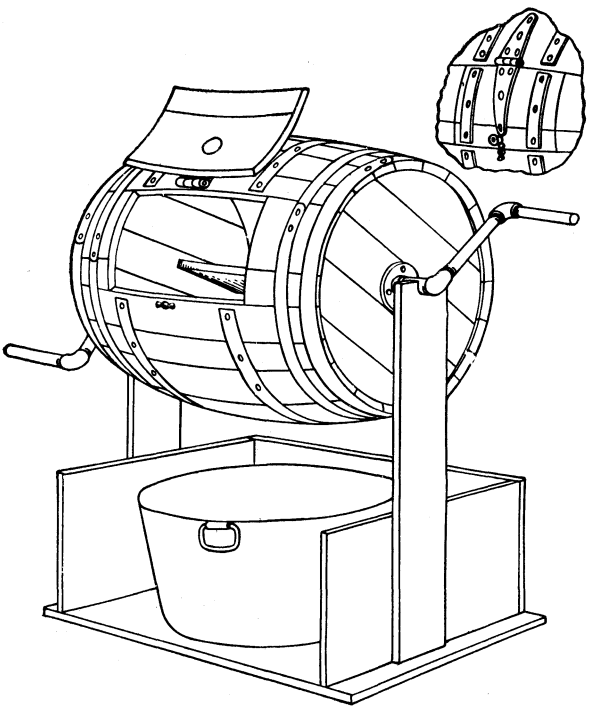

FIGURE 42.—A barrel mixer for treating seed wheat with copper-carbonate dusts. (Designed by F. W. Oldenberg, University of Maryland.)

ity-type mixer is shown in figure 43. Such a mixer is suitable only for the application of a volatile dust, such as New Improved Ceresan. For copper carbonate and basic copper sulphate, a mixer similar to those shown in figures 41 and 42 is required in order to insure a satisfactory coverage of the grain. In using the gravity-type (fig. 43)

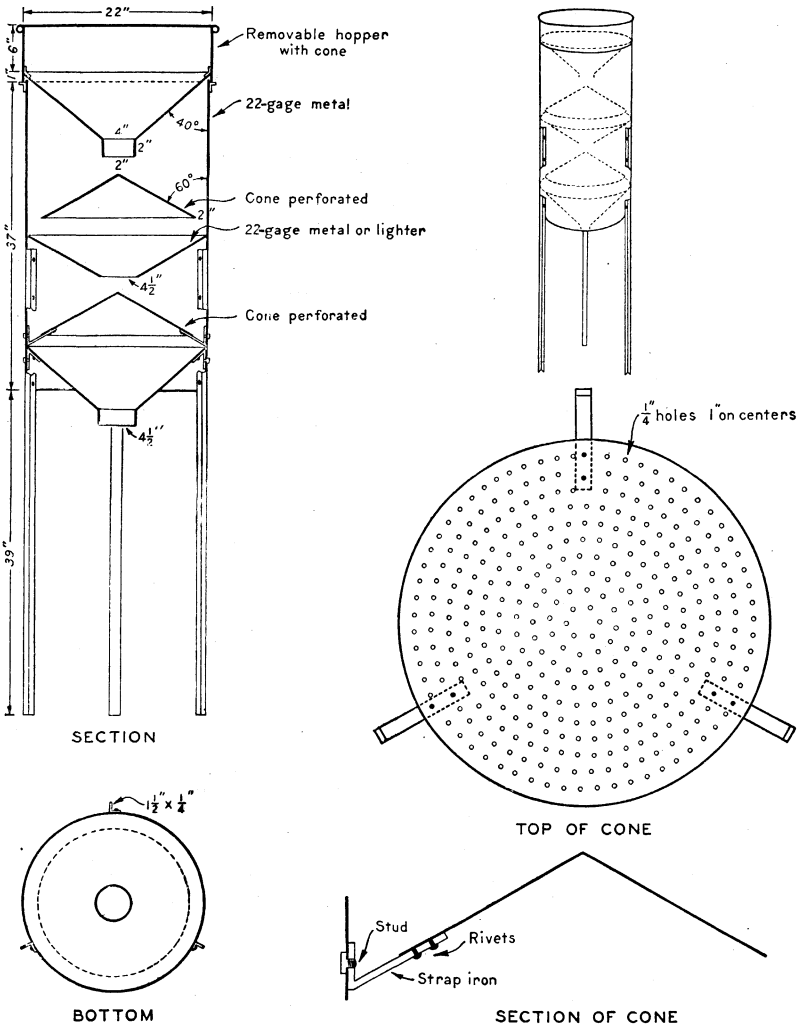

FIGURE 43.—A gravity mixer for treating seed wheat with New Improved Ceresan. Not suitable for copper carbonate or basic copper sulphate.

the disinfectant is applied gradually at the rate of one-half ounce per bushel as the seed grain is poured into the hopper. For this purpose a half-ounce measure is supplied by the manufacturers of the disinfectant so that the latter may be handled without coming in contact with the hands of the operator.

Large-scale seed treatment by local elevators, seed houses, central treating plants, or portable treating outfits is practical and valuable and is increasing in popularity. By means of it farmers can be relieved of the inconvenience of treating, and a more uniform and satisfactory job of treating can be done. The task is much easier now than it was several years ago. New materials, methods, and equipment make it possible to treat seed rapidly and effectively at a very low cost per bushel. If it is not desirable to purchase a large-capacity commercial machine, there are several types of apparatus that can be constructed by local carpenters or sheet-metal workers to handle 200 to 500 bushels an hour.

FIGURE 44.—Loose smut in wheat: The infected plants are shorter than the noninfected plants and the glumes (chaff) and grain have been replaced by the black spores of the smut fungus.

LOOSE SMUT

Loose smut is almost always prevalent in the wheatfields of the eastern United States and causes an average loss in yield of about 1.5 percent. Losses in individual fields may amount to 30 percent or more.

Loose smut is very noticeable as soon as the wheat heads (fig. 44). The glumes and other floral parts of the newly emerged heads are almost completely replaced by black masses of smut. For this reason loose smut is frequently called blackhead. The spores are loosely held in the smutted heads and are soon carried away by winds, rain, insects, or other agencies. After the smut is gone only the inconspicuous central stalk (rachis) of the head remains. Some of the spores, in the course of their dissemination, are carried to the flowers within the glumes or chaff of the sound wheat heads. Here the spores germinate and produce an internal infection of the developing kernels. When mature,

the infected kernels cannot be distinguished from noninfected kernels. However, if the former are used for seed without being treated, the internally borne fungus starts growing as the kernel germinates and spreads upward into the plant as it develops. Finally when the heads appear, they are composed of the smut masses described above.

Because the loose smut organism invades the internal parts of the kernel, the disease cannot be controlled through treating the seed with the easily applied surface disinfectants, as described for bunt. It may be effectively controlled by employing what is known as the modified hot water method. This treatment is recommended only for a sufficient quantity of seed to sow a plot distant from the main crop that will serve as a source of clean seed for the following year. It is difficult to apply, however, even to small lots of seed and has not proved popular with growers. In general, therefore, when loose smut becomes important, the best method of combating it is to secure seed from a smut-free field. If it seems desirable to apply the modified hot-water method, directions may be obtained from the State agricultural experiment station or from the United States Department of Agriculture.

FLAG SMUT

Flag smut occurs only to a limited extent in Illinois, Missouri, and Kansas. On susceptible varieties it may cause losses of more than 30 percent, but of plants of the relatively resistant varieties now being grown in most of the infested areas, not more than 1 to 5 percent usually are infected.

Flag smut produces dark stripes in the leaves, sheaths, and stalks. It stunts the plants and usually prevents the formation of normal heads (fig. 45, p. 50). It is carried over from one crop to the next, both with the seed and in the soil of infested fields. It may be controlled most advantageously by the use of adapted, highly resistant or immune varieties of soft red winter wheats, such as Trumbull, Fulhio, Kawvale, and Fulcaster, or hard red winter wheats such as Cheyenne, Kanred, Turkey, Tenmarq, and a number of resistant hybrids.

If susceptible varieties are desired, such as unselected Harvest Queen, the seed should be very thoroughly cleaned and carefully treated with copper carbonate or New Improved Ceresan, and sown on noninfested land.

SCAB

Scab occurs most commonly in the Corn Belt, where occasionally it takes a very heavy toll. Some years it is severe also in the east-central States.

The scab fungus attacks the seedlings and also the heads of the plants. The attacked seedlings are killed or greatly weakened, and the attacked portions of heads are killed. Individual spikelets or various portions of heads may also be killed (fig. 46, p. 51). Usually some pink or salmon-colored masses of spores of the scab fungus are evident at the edges or bases of the affected glumes. The kernels in killed portions become much shrunken, almost white, and scabby in appearance. Hence the name "scab."

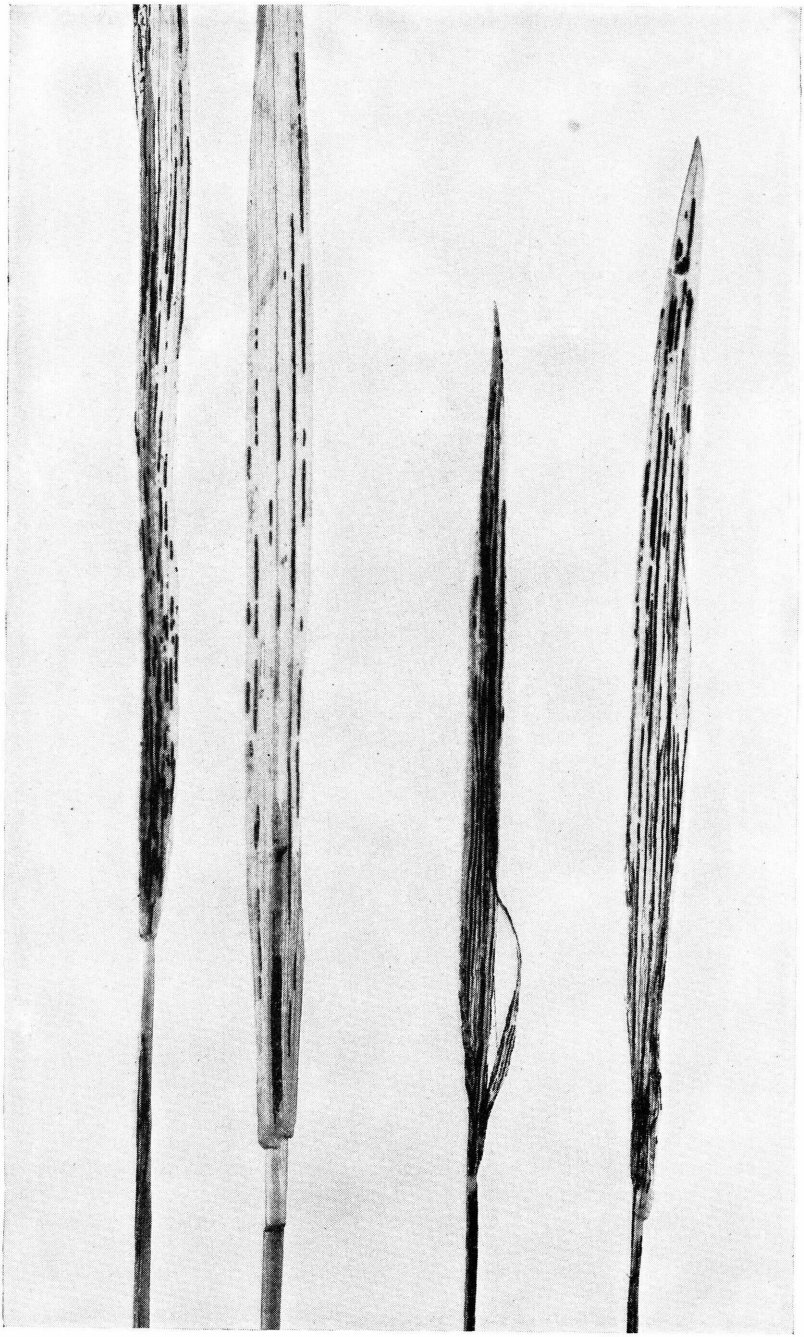

FIGURE 45.—Flag smut in leaves and stalks of wheat.

The scab fungus is carried over from one crop to the next, both with the seed and on old crop refuse, such as cornstalks in the field. The fungus carried with the seed infects the wheat seedlings more or less severely, depending on various conditions at seeding time, and causes seedling blight. The fungus from old cornstalks, if left in the surface of the soil, may infect the heads and cause head blight. It is for this reason that the disease is most severe where wheat follows corn.

Scab is difficult to control. In areas where it is frequently severe, the most effective control is secured by sowing wheat on land other than cornland. Where this is not possible and it is necessary to use the cornland for wheat, the cornstalks either should be very thoroughly plowed under or cut as low as possible and the land very thoroughly disked. In the latter case, all fodder and loose cornstalks should be removed from the fields before the wheat comes into head. In any case the seed should be thoroughly cleaned and treated with New Improved Ceresan before sowing.

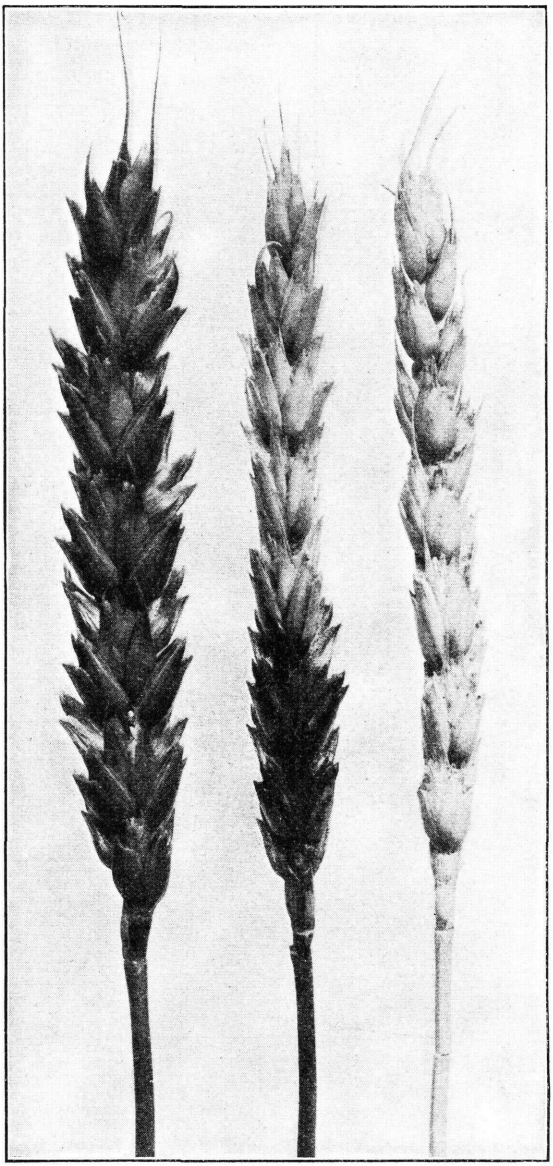

FIGURE 46.—Scab, or blight, on wheat heads: A healthy head (left); part of a head killed (center); the entire head killed (right).

Some progress is being made in the development of wheat varieties resistant to scab, but much remains to be done in this direction before the desired resistance is obtained.

TAKE-ALL

Take-all has been reported from the following States in the eastern half of the United States: Kansas, Arkansas, Indiana, Tennessee, North Carolina, Virginia, Maryland, and New York. It is most important in Kansas and New York. In the other States it has been of minor importance in recent years. In Kansas, in some years, it destroys 10 to 50 percent of the crop in infested fields. Fortunately, infested fields are comparatively few; but, because of possible heavy losses from the disease, it should be carefully watched.

Take-all may kill the plants in the rosette stage; it may so dwarf them that only a few low culms with small heads are formed, or it may kill plants that have attained about the normal size as the heads are beginning to fill. Such plants turn almost white; therefore this development of the disease is sometimes called white heads. Nearly all the plants in certain spots or only a plant or two in a place, variously scattered in the field, may be killed, and various intergrading conditions may occur. In any case the bases of the infected plants usually are black to a height of 1 or 2 inches above the soil, and the plants pull up rather easily because of the rotted, infected roots.

The take-all fungus is not carried with the seed but persists several years in the soil. The only feasible control measure known is to keep wheat, barley, and rye off infested land for about 4 years. In the meantime apparently it is advantageous to plow under some green-manure crop, particularly sweetclover if this is feasible. No resistant varieties are known.

MOSAIC

There are several closely related mosaic diseases of winter wheat in the eastern United States. In the most susceptible varieties, losses up to 75 percent or more may occur in extreme cases.

Wheat mosaic may affect different varieties somewhat differently. On the most susceptible varieties, such as Harvest Queen, extreme dwarfing or rosetting (fig. 47) and also leaf mottling may occur. On other varieties, only the leaf mottling occurs.

The mosaic diseases are caused by viruses, which may persist in the soil for several years. Therefore, susceptible varieties should not be sown in soil known to be infested. The safest procedure, where the disease occurs, is to use only varieties known to be resistant.

While Harvest Queen is one of the most susceptible varieties, resistant strains that are satisfactory have been selected from it. Most winter wheat varieties that have been tested are resistant to mosaic rosette but susceptible to mosaic mottling in different degrees of severity. Selections from certain standard varieties have shown immunity from mosaic rosette and high resistance to mosaic mottling.

NEMATODE DISEASE

The nematode disease occurs to some extent in Maryland, Virginia, West Virginia, North Carolina, South Carolina, and Georgia. Losses on individual farms may range from very slight to as much as 70 percent. The disease occurs on both wheat and rye and is

caused by a species of very small roundworm, called nematode or eelworm, which in the wheat heads forms galls instead of kernels. An infected head of wheat and some nematode galls are shown in figure 48.

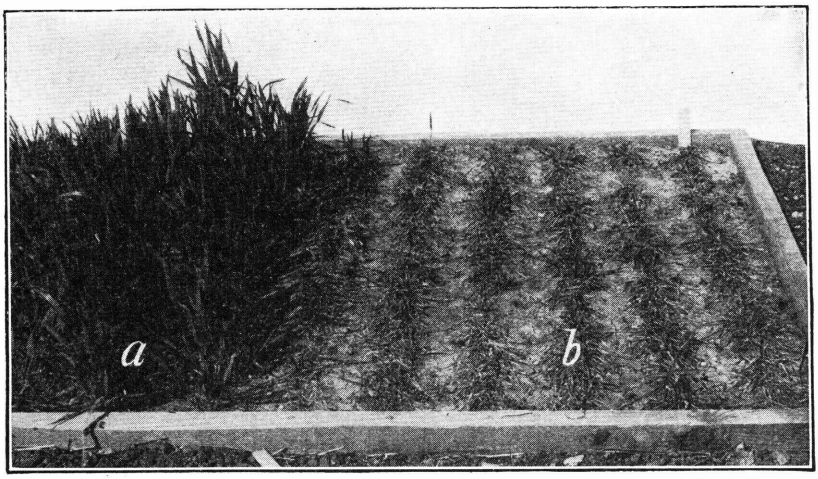

FIGURE 47.—Harvest Queen wheat selections grown in virus-infested soil: The six rows at *b* were a strain selected for high susceptibility to mosaic rosette; the two rows at *a* were a strain selected for resistance to mosaic rosette.

The nematode is carried over from one crop to the next in galls with the seed or in infested soil. The disease may be controlled by using noninfested seed on noninfested soil. It is extremely difficult to remove nematode galls perfectly from seed wheat. Therefore it is

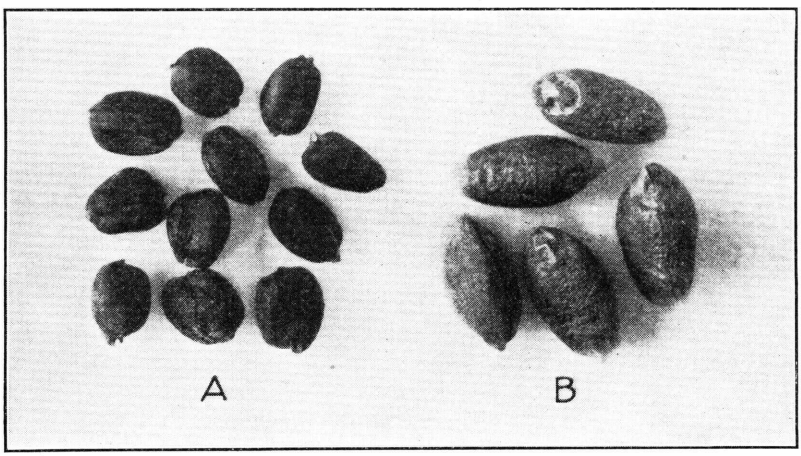

FIGURE 48.—*A*, Nematode galls; *B*, normal wheat kernels.

usually best to secure seed that is known to be free from them and to sow it on land that has neither grown nematode-infested wheat or rye for 1 year, nor had infested manure or infested crop refuse spread on it for 1 year.

WEEDS IN WHEAT [1]

Weeds are often a serious problem in wheatfields in the eastern United States. The most serious are those, like the European or field bindweed, Canada thistle, and wild onion or wild garlic, that live from year to year by virtue of underground stems or bulbs in which reserve foods are stored to carry the plants through unfavorable periods of the year. Such plants are commonly known as perennials. They are regarded as the most serious because they are most difficult to eradicate or control. They occur not only in wheat but in other crops as well. Fortunately, with the exception of wild garlic, they are not widespread in the eastern United States, although elsewhere they occupy thousands of acres of valuable land, and in some cases are so serious as to make the profitable production of crops out of the question. A second important class is the winter annuals, such as chess or cheat, corncockle, dogfennel, chickweed, and skeletonweed, that start growth in the fall with the wheat and mature the following year. Such weeds are troublesome, but usually they can be controlled or completely eradicated by good farming methods.

Wild garlic or wild onion probably is the most objectionable weed in eastern wheatfields. The plant grows from underground bulbs and also from aerial bulblets which ripen with the wheat. The green bulblets are very difficult to separate from wheat, but they shrink during storage and if thoroughly dry may be removed by means of the fanning mill or other cleaning equipment. If not removed, they form gummy masses on the rolls in milling and impart a strong odor of garlic to the flour.

In the official grain standards of the United States, wheat containing two or more green garlic bulblets or their equivalent in approximately 2 pounds of wheat is specially designated as "Light garlicky" or "Garlicky." Such wheat is discounted in price. Wild garlic is a very difficult weed to exterminate, and every effort should be made to keep it off the farm. Those who wish to attempt to eradicate or control it will find further information in United States Department of Agriculture Leaflet 43, Wild Garlic and Its Control.

Cheat or chess is one of the most common weeds in wheatfields in the eastern United States. It is a species of bromegrass and not, as commonly supposed, a degenerate form of wheat. The plant is more hardy than wheat, a fact which sometimes causes fields of wheat apparently to change to cheat over winter. The seeds of cheat are difficult to remove from wheat and are often sown with it, thus perpetuating the cheat from year to year. However, it is possible to remove cheat seed from wheat by careful adjustment of the fanning mill, and when this is done and a good farming system including rotation of crops is used, there is not likely to be serious trouble from this pest. Fortunately the seeds of cheat do not live long in the soil.

Corncockle or purple cockle is often found in fields of winter wheat in the eastern United States. The rough, dark-colored seeds are difficult to separate from wheat if present in appreciable quan-

[1] Contributed by L. W. Kephart, senior agronomist, Division of Cereal Crops and Diseases.

tities and produce a dark, bad-flavored flour of poor quality. Also the cockle seeds are reputed to be poisonous to poultry. The seeds do not live long in the soil, and the use of clean seed, together with careful cultivation and suitable rotations, will eradicate the pest.

Dogfennel, chickweed, skeletonweed, wintercress, and similar weeds, if they occur in large numbers, crowd the stand of winter wheat and may reduce the yield seriously. With the exception of chickweed and wintercress, they are likely to be less troublesome in late seedings than in early ones. They also can be controlled by good farming methods.

INSECTS THAT ATTACK WHEAT [2]

HESSIAN FLY

In the principal areas where soft red winter wheat is grown the hessian fly (*Phytophaga destructor* (Say)) is without doubt its most formidable insect enemy. A portion of a wheat plant infested with hessian fly maggots is shown in figure 49. The most important and practical means of control for this pest, as indicated on page 37, is to plant winter wheat at a date that will delay the appearance of the young wheat above ground until after the main brood of flies has emerged and died. Sound cultural practices that contribute to the vigor of the growing crop are an important help in combating the hessian fly. Chief among these are the sowing of good seed, the proper fertilization of the soil, and a well-prepared, firm seedbed.

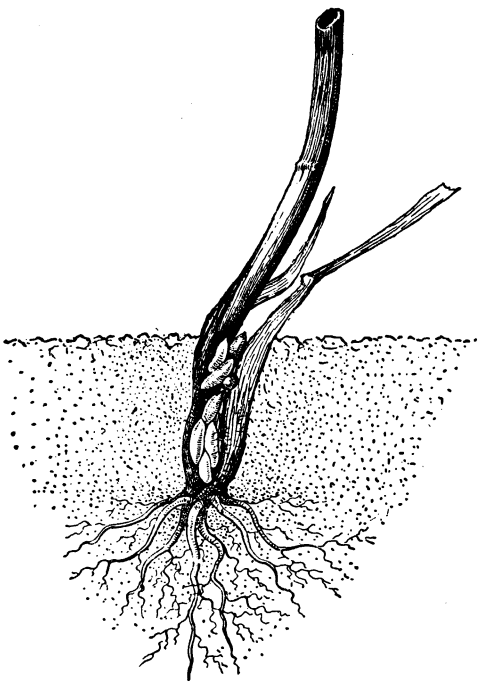

FIGURE 49.—Hessian-fly maggots beneath leaf sheath in the soil. (× 1.)

WHEAT JOINTWORM

The wheat jointworm (*Harmolita tritici* (Fitch) is considered one of the most consistently injurious insect enemies of the soft wheats in the East Central and Atlantic States. The way the wheat jointworm attacks the plant is illustrated in figure 50. Its work usually remains undetected, and losses caused by it are often attributed to unfavorable weather or cultural conditions. It robs the heads of nourishment by causing hard knots or galls in the stems. Where very abundant, it may cause lodging of the ripening grain and thus call attention to its presence. Jointworm may be controlled by

[2] Contributed by the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

cutting the wheat as high as practicable and plowing under the stubble immediately after harvest in order to bury it so that the jointworm adults cannot emerge. This, of course, is not generally practicable where grass, clover, or other legume is seeded with the wheat, except

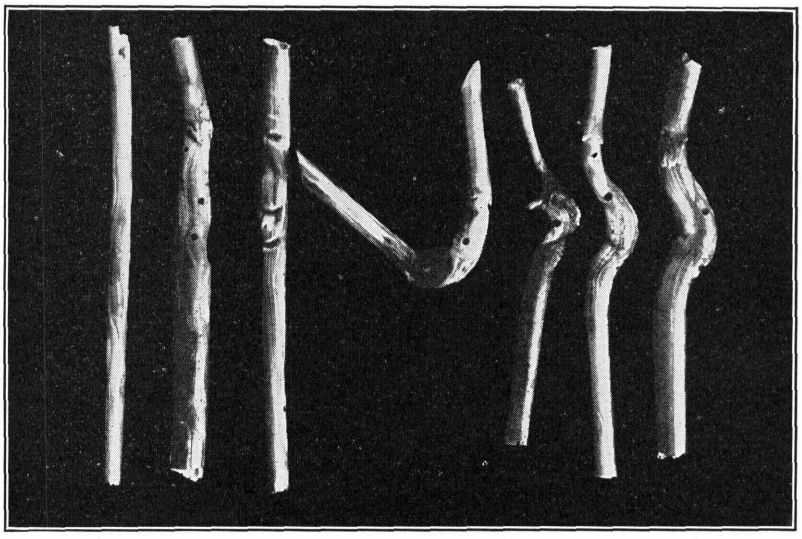

FIGURE 50.—Work of the wheat jointworm. (Natural size.)

in cases of extremely heavy infestation. Farmers' Bulletin 1006, The Wheat Jointworm and Its Control, contains additional information on this insect.

SAWFLIES

The black grain-stem sawfly (*Trachelus tabidus* (F.)) and the European wheat-stem sawfly (*Cephus pygmaeus* (L.)) occur in the North Atlantic States, the first-named species having recently spread into and become a serious wheat pest in eastern Ohio.

Where the sawflies have become abundant, serious losses are likely as a result of the breaking-over of straws, shattering of grain, and difficulty of harvesting.

The sawfly larva is a yellowish-white worm with a brown head, which develops from an egg laid by a small wasplike insect inside the wheat stem about the time of heading. The worm feeds inside the stem and gradually works its way downward until by harvesttime it has become full-grown and about three-eighths of an inch long. It then cuts a ring almost through the stem wall close to the ground, leaving just enough outside fiber intact to hold the stem erect until it can securely plug the end of the stub, in which it forms a resting cell. As the stem dries and becomes brittle, the weight of the head, together with wind or rain, causes the stem to break off close to the ground, where the worm has cut around it inside. The larva remains in the stub until the following spring, when it changes to the adult-wasp stage and emerges to lay eggs in the currently maturing crop.

No entirely satisfactory method of controlling sawflies is known. Plowing under stubble at least 6 inches deep with thorough coverage,

where possible, before the spring emergence of the adults, is beneficial. However, this practice would have to be followed throughout whole communities to be materially effective. Furthermore, it conflicts with the well-established and desirable practice of planting clover or timothy in the wheat.

Two other helpful measures are recommended in heavily infested areas. Thorough cultivation and fertilization to produce a strong, heavy stand help materially to reduce loss; and cutting the wheat as early as possible before it has a chance to break over as a result of sawfly injury prevents losses due to lodging and shattering.

CHINCH BUG

Although the chinch bug (*Blissus leucopterus* (Say)) has long been known as a principal insect enemy of wheat, this evil reputation has not been justified by its behavior during the past 25 years in soft red winter wheat. Chinch bugs do feed on and deposit eggs upon these wheats, but their vigorous growth and early maturity force the bugs to migrate to corn, usually before serious injury has occurred to the wheat. In the spring the bugs tend to congregate in the thinner, poorer parts of the fields and in years of extreme abundance often kill or greatly reduce the growth of the wheat in such areas. A heavy stand of soft red winter wheat is seldom seriously injured by chinch bugs; this is fortunate, as no thoroughly satisfactory method of protecting this crop has yet been devised. Promoting a heavy, thrifty stand of wheat, preferably intermixed with clover, is a good protective measure.

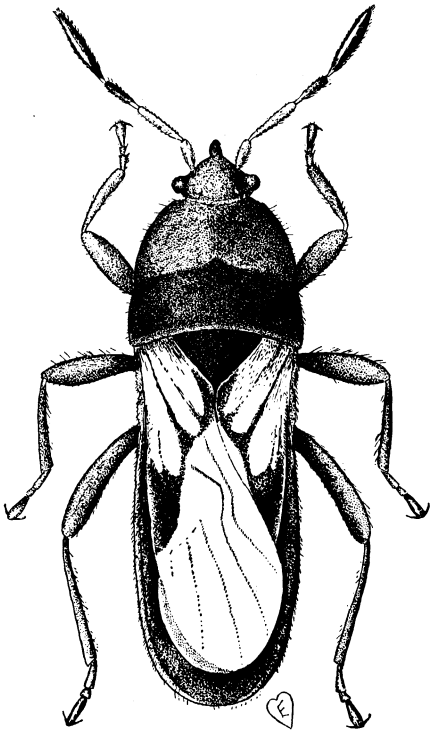

FIGURE 51.—An adult chinch bug. (× about 19.)

In years of abundant chinch bugs, spring wheat grown within the range of chinch bug infestation is almost certain to be seriously damaged. Its younger stage of growth at time of infestation and longer period of succulence thereafter render it most attractive to the bugs. An adult chinch bug is shown in figure 51.

The practice of winter burning of the grasses and leaves in which it hibernates, often advocated for the control of chinch bugs in the hard wheat region, is not generally advisable in the main area devoted to soft red winter wheat production. Under ordinary conditions not more than 25 percent of the bugs can be killed in this way, and as a rule there are serious disadvantages in this operation. Where it is possible safely and effectively to burn a limited area

known to harbor large numbers of bugs, this should be done, either early in the winter after all the bugs have congregated in the grasses or before the first warm spell in spring, prior to the first flight of bugs. Farmers' Bulletin 1780, How to Fight the Chinch Bug, contains further information regarding the chinch bug.

ARMYWORM

In years favorable to its development, the armyworm (*Cirphis unipuncta* (Haw.)) (fig. 52) sometimes inflicts serious and widespread damage on the winter wheat crop. This is most likely to occur in the southern halves of the East Central and Middle Atlantic States, and to follow the occurrence of a mild, open winter that has merged into a cold, wet spring. Ordinarily, the armyworm is effectively suppressed by its numerous natural enemies, but the foregoing

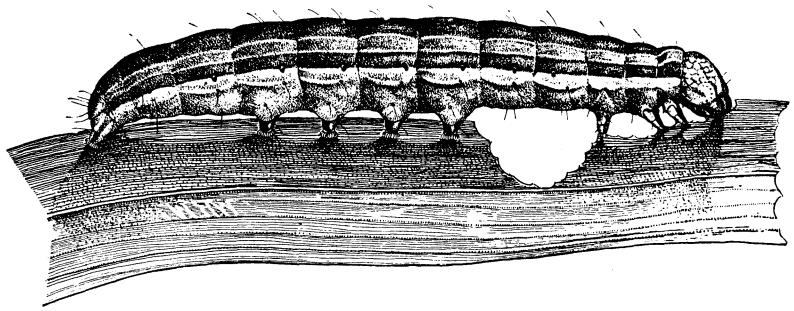

FIGURE 52.—An armyworm larva. (× about 3.)

meteorological sequence may permit it to escape them and do great injury to the growing wheat. In this case the prompt distribution of poisoned bran bait is advised. The formula is as follows: Wheat bran, 50 pounds; paris green or crude arsenic, 2 pounds; blackstrap molasses, 2 quarts; water, 6 gallons. Mix the bran and poison thoroughly together while dry; then add the diluted molasses and stir well until thoroughly mixed. Broadcast the bait thinly, not in lumps, over the infested field late in the afternoon.

In its early stages, the armyworm usually works concealed among the lower leaves of the grain, and frequently its presence remains undetected until it has developed to a large size and is doing great damage to the heads of the grain. Its early detection is necessary to prevent serious loss.

Other insects sometimes seriously injurious to winter wheat are the green bug, sod webworms, and wireworms. For information regarding these and other insect pests of wheat, apply to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D. C.

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